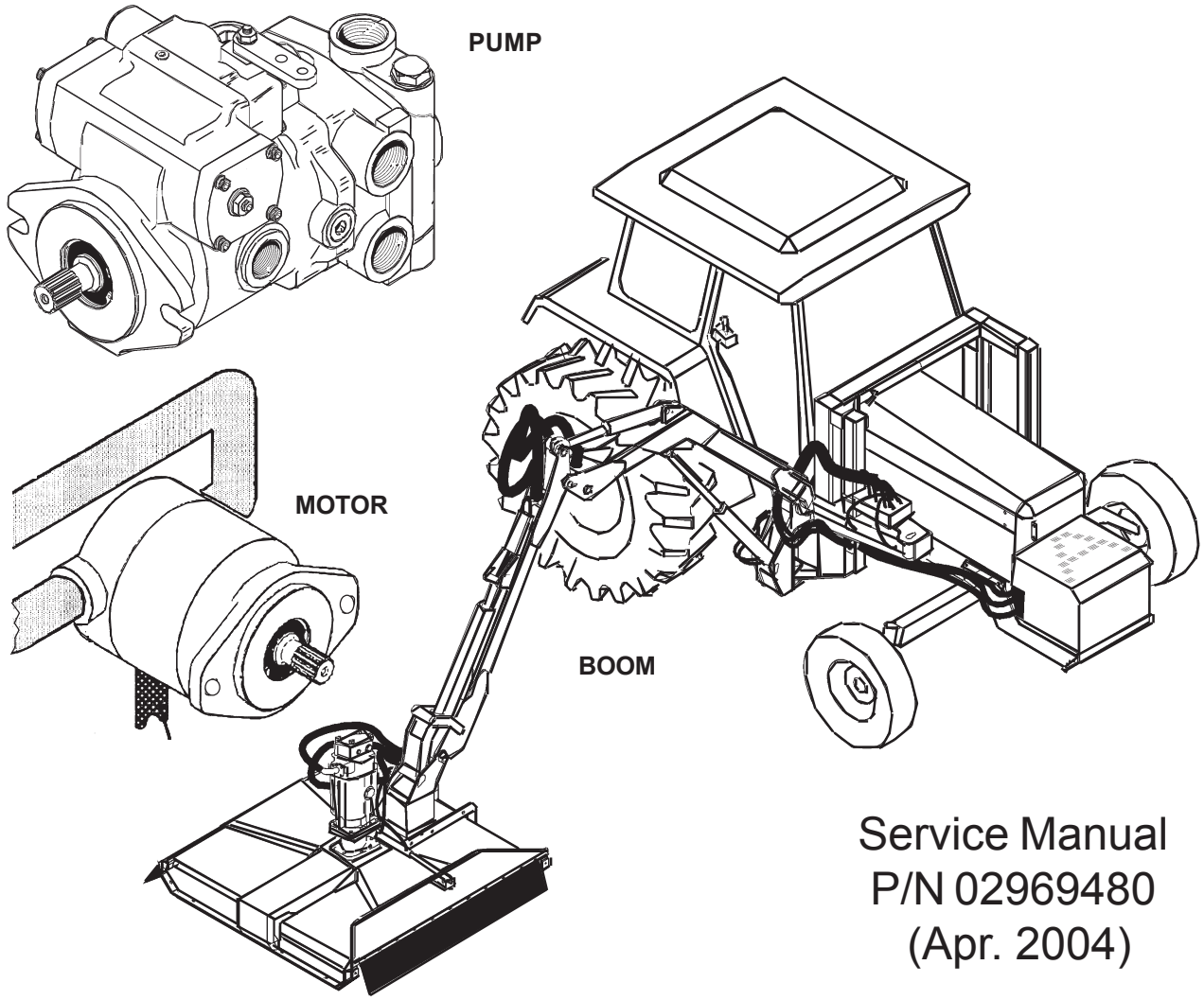
ALAMO INDUSTRIAL

MACHETE™

BOOM ARM MOWER

PRODUCT SERVICE MANUAL



Service Manual
P/N 02969480
(Apr. 2004)

Alamo Industrial
1502 E. Walnut
Seguin, Texas 78155
830-372-1480

MEMBER OF THE ALAMO GROUP
ALWAYS ON THE CUTTING EDGE

2004 Edition

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INTRODUCTION

ABOUT THIS MANUAL:

The intent of this publications to provide the competent technician with the information necessary to perform the CORRECT repairs to the Alamo Industrial Product. This will, in turn provide for complete customer satisfaction

It is hoped that the information contained in this and other Manuals will provide enough detail to eliminate the need for contact of the Alamo Industrial Technical Service Dept. However, it should be understood that many instances may arrive wherein correspondence with the Manufacturer is necessary.

CONTACTING MANUFACTURER: (Please help us Help You! Before You Call!)

Alamo Industrial Service Staff Members are dedicated to helping you solve yours or your customer's service problem as quickly and efficiently as possible. Unfortunately, we receive entirely to many calls with only a minimum amount of information. In some cases, the correspondent has never gone out to look at the equipment and merely calls inquiring of the problems described to him by the operator or customer.

Most calls received by Alamo Industrial Service can be classified into approx. 6 general categories.

1. Hydraulic or Mechanical Trouble Shooting.
2. Request for Technical Information or Specifications.
3. Mounting or Fitting Problem.
4. Special Service Problem.
5. Equipment Application Problems.
6. Tractor Problem Inquiries.

HOW YOU CAN HELP:

Make sure the call is necessary! Most of the calls received may not be necessary if the Dealer Service Technician would do the following.

1. Check the Service Information at your Dealership provided by Alamo Industrial, This would include, Service Bulletins, Information Bulletins, Parts Manuals, Operators Manuals or Service Manuals, many of these are available via the Alamo Industrial Internet site (Alamo - Industrial. Com). Attempt to diagnose or repair problem before calling.

2. If a call to Alamo Industrial is needed, Certain Information should be available and ready for the Alamo Industrial Service Staff. Such information as, Machine Model, Serial Number, Your Dealer Name, Your Account Number and Any other information that will be useful. This information is vital for the development of a prompt and correct solution to the problem. This will also help to develop a database of problems and related solutions, which will expedite a solution to future problems of a similar nature.

3. The technician may be asked to provide detailed information about the problem including the results of any required trouble shooting techniques. If the information is not available, The technician may be asked to get the information and call back. Most recommendations for repairs will be based on the procedures listed in the Service Manual / Trouble Shooting Guide.

CONTACT ALAMO INDUSTRIAL:

Alamo Industrial, 1502 E. Walnut St. Seguin TX. 78155, Technical Service Dept. PH: 830-372-2708

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INDEX - REPAIRS

	Page
INTRODUCTION	**3**
SPECIFICATION	**10 thru 13**
Boom Specifications	10
Cutting Circuit Specifications	10
Filtration Specifications	10
Hydraulic Cylinder Specifications	11
Hydraulic Hose Specifications	12
Hydraulic Hose Torque Specifications	14
Hydraulic Pump Specifications	11
Hydraulic Valve Specifications	12 -13
General / Speceial Torque Specifications	14
BLADE BAR	**121 thru 128**
Blade Bar Assemble & Dis-Assemble	138 - 142
Blade Bar Torque Specification	138
Blade Bolt Torque Specifications	138
Blade Bar Installation Instructions	142
KING PIN	**132 thru 135**
Tools Required List (Recommended Tools)	132
Tool Description	134
King Pin Removal Procedure	132 - 133 - 134
King Pin Bushing Replacement	134 - 135
PUMP	**61 thru 82**
Pump Charge Pump Adapter Asy	77
Pump Dis-Assembly Instructions	72 - 73
Pump Introduction	61 - 62 - 63
Pump Manual Servo Control Asy	78 - 79 - 80
Pump - Motor Engage Requirements	66
Pump - Motor Dis-Engage Requirements	66 - 67
Pump Parts Location	68 - 69 - 70 - 71
Pump Re-Assembly	74 - 75 - 76
Pump Rotaiting Kit Asy	81 - 82
MOTOR CIRCUIT	**83 thru 94**
Motor Electrical Control	84 - 85 - 86 - 87 - 88
Motor - Pump Actions	89 - 90 - 91
Motor System Schematic	92
Motor Shuttle Valve Location	93
Motor Service & Repair	94
Motor Component Torque Specification	111
Motor Dis-Assembly	101 - 102 - 103

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INDEX - REPAIRS

	Page
MOTORP/N 02967193 (60" HEAD MOTOR)	95 thru 114
Motor End Cover Dis-Assembly	101
Motor Parts Location	96 - 97
Motor Re-Assembly	105 thru 110
Motor Tool Descriptions	111 thru 113
Motor Valve Block Dis-Assembly	98 - 99
Motor Valve Block Re-Assembly	100
MOTOR P/N 02979881 (50" HEAD MOTOR)	115 thru 130
Motor Parts Location	116 - 117 - 118
Motor Dis-Assembly	119 - 120 - 122 - 123
Motor Re-Assembly	124 thru 129
Shaft Seal Replacement	129
SPINDLE	**138 thru 144**
Blade Bar Removal	138
Blade Bar Installation	142
Motor Plate Removal	139
Motor Plate Installation	142 - 143 - 144
Motor Removal From Spindle	139
Motor Installation on Spindle	142
Spindle Removal From Deck	139
Spindle Installation on Deck	142
Spindle Dis-Assembly	140
Spindle Re-Assembly	141
Spindle Cleaning & Inspection	139
TROUBLE SHOOTING	**See Below**
Problem, Cause And Solution	145 thru 178
Valve Testing Procedures	54 thru 60
VALVE	**15 thru 60**
Joystick Control / Trouble Shooting	19 - 20 - 21
Joystick Plug	22 - 23 - 24
Joystick Wirineg Harness	19 - 22 - 23 - 24 - 25
Valve Components	26 - 27 - 28 - 29 - 30
Valve Operation	17-18
Valve Parts	40 thru 45 & 46 thru 52
Valve Trouble Shooting	53 thru 60
Wiring Harness, General View	16
Wiring Harness, Plug	25
Wiring Harness, Joystick	22 - 23 - 24
Hydraulic Flow, load Sensing	31 - 32 - 33 - 34
Hydraulic Flow, Fixed Displacement	35 - 36 - 37 - 38

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DRAWING INDEX

THIS INDEX INDICATES FIGURE (DRAWING) LOCATION

PROCEDURE		Fig.#	Pge.#
BLADE BAR...	Removal (Rotary Head)	85	122
JOYSTICK.....	Assembly	4	19
	Plug Pin Location	6	22
KING PIN.....	Boom Removal	80	132
	Boom Mount	81	133
	King Pin Removal	81	133
	King Pin Bushing Driver	82	134
	Bushing Removal & Replacement	83	134
	King Pin Replacement	84	135
MOTOR.....	Circuit Electric Schematic (Old Style)	36	85
	Circuit Electric Schematic (Mid Style)	37	86
	Circuit Electric Schematic (New Style)	38	87
	Circuit Pump Engage	40-42	65-67-89-91
	Circuit Pump Engage	41	66-90
	End Cover Dis-Assembly	56 thru 58	100-101
	End Cover Re-Assembly	70 thru 73	108-109
	Input Seal & Bearing Removal	47-59	102-103
	Main Housing Re-Assembly	69	107
	Motor Components Torque Specifications	------	111
	Motor Repair Tools Descriptions	77 thru 79	111 thru 113
	Output Shaft Assembly Removal	60-61	103
	Rotating Group Dis-Assembly	63-64	104
	Rotating Group Re-Assembly	65-66	105
	Parts Location	46	96
	Shuttle Valve Dis-Assembly	44-45	93
	Shuttle Valve Re-Assembly	75	110
	System Hydraulic Schematic	43	92
	Valve Block Dis-Assembly	48 thru 51	98 thru 99
	Valve Block Re-Assembly	52 thru 55	99 thru 100
	Valve Block O-Ring/Back-Up Ring Replace.	76	110
	Motor Plate Dis-Assembly	86	123
	Motor Plate Re-Assembly	89 thru 95	127 thru128

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DRAWING INDEX

PROCEDURE		Fig.#	Pge.#
PUMP.....	Electric Control	39	88
	Circuit Motor Engaged	40-42	65-67-89-91
	Circuit Motor Disengaged	41	66 and 90
	Charge Pump Adapter Assembly	30-31	77
	Dis-Assembly	27-28	72 thru 73
	Re-Assembly	29	74
	Parts Location	25-26	68 thru 70
	Port Locations	24	63
	Rotating Kit Parts Location	34	82
	Pump / Motor Port Connections	39	64
SERVO CNTRL.	Control System	40	65
	Control Assembly (Manual Type - Old Style)	32	79
	Control Assembly (Manifold Type - New Style)	33	80
	Control Electric Control	39	88
SPINDLE.....	Blade Bar Removal (Rotary Head)	85	138
	Blade Bar Replace (Rotary Head)	85	138
	Motor Plate Removal (Rotary Head)	86	139
	Motor Removal (Rotary Head)	86	139
	Spindle Dis-Mount from Deck (Rotary Head)	86	139
	Spindle Dis-Assembly	87	140
	Spindle Re-Assembly	88	141
	Spindle Re-Mount to Deck	89 thru 95	143 thru144
	Motor Plate Installation	89 thru 95	143 thru144
VALVE, 5 SPL	Specific Section Operation	2	17
	Components	11 thru 14	27 thru 30
	Hydraulic LocK Valve	3	18
	Operation	15 thru 18	32 thru 38
	Part Numbers	-----	40 thru 51
	Testing	19 thru 23	56 thru 60
	Type	10	26
WIRING SYS.	Harness Schematic, Joystick End	7-8	23 thru 24
	Harness Schematic, Vlave End	9	25
	Harness Valve Plug (Old Style)	5	22
	Harness Valve Plug (Old & New Style)	35	84
	Control Valve Wiring	1	16
	Plug Pin Location	6	22

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Specifications Section

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SPECIFICATIONS - MACHETE

1. Cutting Circuit Specifications

Hyd. Pump Speed (Front Aux Pump)	1950 RPM
Hyd. Motor Speed	1220 RPM
Hyd. Motor Rated HP	199 HP
Hyd. Motor Rotation (as viewed f/ Top of the Deck)	CW (Clockwise)
Relief Valve Setting At Motor	4000 PSI
Relief Valve Setting At Pump	4500 PSI
Hyd. Pump Flow (Front Pump @ 1950 RPM)	25.3 GPM
Hyd. Oil Operating Temperature	95 Deg, (F) Above Ambient
Hyd. Oil Filtration, (Discharge f/ Charge Pump)	10 Micron
Hyd. Tank Capacity	17 Gal.
Hyd. Motor Circuit Oil Type *	ISO AW 100 Hyd Oil
Hyd. Motor Start Stop Time (Approximate)	6 Seconds
Cutting Diameter, (Rotary Head)	58 Inch
Spindle	4.5 " by 9" Heat Treated Alloy
Blade Bar Type	Stacked 3 Leaf
Blade Bar Size	1-1/4" Thick X 5" Wide (Ea. Leaf)
Blade Bar Material.... Bottom Leaf	T1 Steel
Middle & Top Leaf	HRFB Steel
Blade Swing	360 Deg Swing
Blade Material	High Carbon Alloy Steel
Cutter Weight. (Approximate w/ Rotary Head)	950 lbs.
Cutter Deck Opening & Closing	Hyd. Operated Door

*** Older models recommended Universal Tractor Hydraulic Oil,** This was changed to ISO AW 100 Hyd. Oil, If changing Oil in Older units switch to New Oil, DO NOT Mix types of Oil.

2. BOOM SPECIFICATIONS

Boom Reach 21 Foot Boom	Up 20'-3"	Out 21'-4"	Down 12'-11"
24 Foot Boom	Up 23'	Out 24'-2"	Down 14'-5"
Frame (Old Low Frame)	4" X 6" Rect, Tube		
(New High Frame)	4 X 4 Sq. Sq. Tube (formed corners)		
Pins	Chromed		
Bushings	Self Lubricating (No grease needed)		
Weight (vary w/ size of Boom not include Head)	21 ft = 2250 lbs.	24 ft = 2300 lbs.	
Weight, Head Only (Add to Boom when used)	60" Rotary = 950 lbs., 48" Flail = 770 lbs., FML100H = 990 lbs.		
Boom Rest	Tractor Axle Mounted		
Boom Mounting	ROPS or CAB Tractor Optional		

3. FILTRATION

Control Valve Functions: Control functions include All Hydraulic Cylinders, These are powered by the Tractor Hydraulic System and are protected by the Tractors Filtration system. Maintenance and specification of this should be per Tractor Manufacturer instructions. Later Models Had an Inline Filter assembly (P/N 02976066) added to Filter Tractor System between Valve and Tractor. Change Filter every 200 to 250 hrs. Operation recommended maximum.

Mower Head Functions: Mower Head Functions are operated by Pump, which is mounted to the front of the Tractor Engine. This will have an inline Filter installed into hydraulic circuit, This filter should be changed on a regular maintenance schedule. Filter are rated by Micron size (10 Micron), Filter should be replaced with the same Micron and High Pressure rated Filter.

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4. HYDRAULIC PUMP CIRCUIT

Pump Type	Piston Type
Pump Speed (Front Engine Mounted)	1950 RPM
Relief Setting at the Pump	4500 PSI
Pump Flow (Front Engine Mounted @ 1950 RPM)	25.3 GPM
Oil Operating Temperature	100 deg. (F) above Ambient Temp
Filter, Discharge from Charge Pump	10 Micron
Hydraulic Tank Capacity	17 Gallons
Hydraulic Oil Type (Pump & Motor Circuit)	ISO AW 100 HYD OIL
Motor Start / Stop Time (Approximate)	6 Seconds

5. HYDRAULIC CYLINDERS SPECIFICATIONS

Hydraulic Cylinder Drift Rates:

Cylinder Function	Travel	Time
Lift	1" Travel	8.0 minutes
Dipper	1" Travel	7.1 minutes
Tilt (w/hyd. lock closed)	1" Travel	No Drift
Tilt (w/hyd. lock open)	1" Travel	5.8 minutes

Measured Cylinder Drift Rates are measured as the amount of time required for the rod to move 1", The times shown represent the nominal times for a new machine. The times should be expected to decrease somewhat over time. Drift rates exceeding the times given (meaning that it takes LESS time for the Rod to move 1") may indicate a leakage problem in the Cylinder, Lines or Valves.

Hydraulic Cylinder Pressure Rates:

See Valve Spool Functions & Specs for Rates.

Hydraulic Cylinder Repair Specs:

Cylinder Part No.	Cylinder Function	Piston Nut Torque ft. lbs.	Gland Torque ft. lbs.	Seal Kit Part No.
02967172	Swing (21' & 24')	400-500	135-149 (Cap)	02968612
02967172A	Swing (21' & 24')	400-500	80-120 (Head)	02975530
02967173	Lift (21' & 24')	400-500	135-149 (Cap)	02968610
02967173A	Lift (21' & 24')	400-500	80-120 (Head)	02975527
02967174	Dipper (21' & 24')	400-500	135-149 (Cap)	02968610
02967174A	Dipper (21' & 24')	400-500	80-120 (Head)	02975527
02967175	Tilt (21' & 24')	400-500	135-149 (Cap)	02968612
02967175A	Tilt (21' & 24')	400-500	80-120 (Head)	02975530
02961480	Door (Rotary)	150-250	100-120 (cap)	02972147
02961480A	Door (Rotary)	150-250	80-120 (Head)	02975528
02970710	Door (Flail Axe)	40-60	None (Lockwire)	02972762
02970710A	Door (Flail Axe)	40-60	80-120 (Head)	02975532
02971423	Slide (Timber Cat)	400-500	50-60 (Tie Rod)	02973505
02811000	Door (Ditcher)	150-250	None (Lockwire)	02840600
02811000A	Door (Ditcher)	150-250	80-120 (Head)	02975528

Continued Next Page

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6. HYDRAULIC HOSE CODES

Hydraulic Hose Band Mark Color Codes:

Hose's and/or fittings are marked with a Color Coded Plastic Band around it. Some Bands are a solid Color and some have a Colored Stripe. DO NOT remove these bands unless you replace them. All Bands with Solid Colors connect to Rod End of Cylinder. All Bands with Stripes connects to Butt End of Hydraulic Cylinder (or connections leading to them).

Always Check Hose Size & Color Code

Color Tie	Color Tie Abbreviation	Hose Size	Hydraulic Connection
Orange	OR	Medium	Lift Cylinder, Rod End
Orange	OR	Large	Return Flow from Motor
Orange / White Stripe	OR / W	Medium	Lift Cylinder, Butt End
Green	G	Medium	Swing Cylinder, Rod End
Green / White Stripe	G / W	Medium	Swing Cylinder, Butt End
Blue	B	Medium	Dipper Cylinder, Rod End
Blue	B	Large	Case Drain for Motor
Blue / White Stripe	B / W	Medium	Dipper Cylinder, Butt End
Red	R	Medium	Tilt Cylinder, Rod End
Red	R	Large	Pressure Flow to Motor
Red / White Stripe	R / W	Medium	Tilt Cylinder, Butt End
Yellow	Y	Small	Door Cylinder, Rod End
Yellow / White Stripe	Y / W	Small	Door Cylinder, Butt End

7. VALVE SPECIFICATIONS

Valve Type:

Electrically controlled, Pilot Operated, 5 Spool, Proportional Control Valve, Available as Closed Center Load Sense (CCLS) or Open Center Fixed Displacement (OCFD) Option depending on Requirements of Tractor Model / Series

Valve Construction:

Individual Spool with Tie Rod Bolt together type.

Valve Controller:

Electrical Joystick, Reaction Time = 300 Milliseconds, Voltage Rated = 12 Volt with a 11 to 15 Volt Range.

Valve Port Markings:

Ports Marked with letter "A" (solid marking hose bands) are for Functions Connected to Rod End of Cylinders. Ports Marked with letter "B" (Striped marking hose band) are for Functions Connect to Butt End of Cylinders. (See Decal # 02969106 Hydraulic Hose Hook-Up on Next Page).

Continued Next Page

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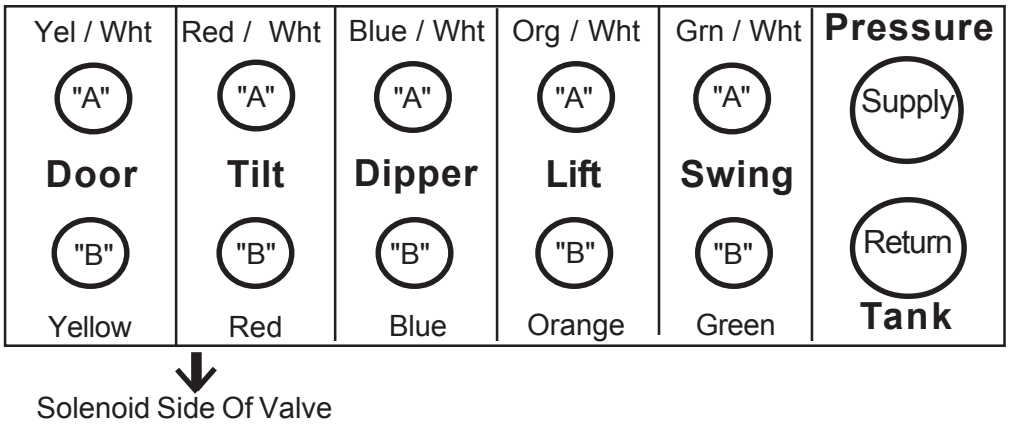
SPECIFICATIONS - MACHETE

Note: Old style Valve (Apitech 10 Plug Wire Harness type) is not shown Below, this is the later style 5 Plug Harness type.



8. Valve Restrictors:

The Restrictors Vary in size from Spool to Spool, Some Ports do not use restrictors at all, See parts page for types and sizes. Restrictors operate by controlling the rate of flow to or from a Cylinder, This is most commonly done by the size of the Hole the Oil is sent through, But can be done by Hose Size. There are also 1 way and 2 way restrictors, Check Parts pages. DO NOT Remove, Change or Modify Restrictors.

Valve Spool Funtions & Specs:

Port Marked	Spool No.	Cyl. Function	Cyl. Travel	Flow GPM	Pressure Rating	Restrictor Size	Cycle Time
"A"	1	Swing	Forward	2.3	2000 psi.	0.040"	8.5 Seconds
"B"	1	Swing	Back	3.5	2000 psi.	0.050"	9.0 Seconds
"A"	2	Lift	Down	4.5	1000 psi.	---------	12 Seconds
"B"	2	Lift	Up	6.5	2000 psi.	0.070"	11 Seconds
"A"	3	Dipper	Out	4.0	2300 psi.	0.063"	10 Seconds
"B"	3	Dipper	In	5.5	1000 psi.	----------	10 Seconds
"A"	4	Tilt	Up	4.0	System	0.050"	6.0 Seconds
"B"	4	Tilt	Down	4.0	System	Lock Valve	8.0 Seconds
"A"	5	Door	Open	2.5	System	----------	5.0 Seconds
"B"	5	Door	Close	2.5	System	----------	6.0 Seconds

Valve Spool Functions & Specs:

In the Chart Cycle Times listed above are close approximations of actual times based on machine testing, Times indicate the time for the Cylinder to travel the full amount of its extension or retraction. The lift times up and down are taken with the dipper fully extended and begin with the Deck flat on the ground. All Cycle times are measured at the rated Tractor RPM. Test Times should be close to above but can vary some from unit to unit; Times listed are a guide to show approx. what Cycle times for tour Unit should be.

Valve Leakage: Maximum internal Valve Leakage from the Cylinder. Ports to Tank at any Valve Segment, Oil Pressure at 1450 PSI and Oil Viscosity at 102 SSU = 1.25 Cubic Inch / Minute

Standby (Pilot) Pressure: Standby (Pilot) Pressure = 200 to 250 PSI.

Continued Next Page

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SPECIFICATIONS - MACHETE

9. HOSE END FITTING TORQUE SPECS:

Hose End Type: 37 Degree Angle End Steel Hose End Fittings*

Dash Size	Nominal Cyl. Size (in.)	Torque in. lbs.	Torque ft .lbs.
-4	1/4"	140	12
-6	3/8"	230	19
-8	1/2"	450	38
-10	5/8"	650	54
-12	3/4"	900	75
-16	1"	1200	100
-20	1-1/4"	1600	133
-24	1-1/2"	2000	167
-32	2"	2800	233

* Straight Threads do not always seal better when higher torques are used. Too much torque causes distortion and may lead to leakage. DO NOT over torque fittings and DO NOT allow any contaminants to enter system through fittings when installing them.

10. Special Torque Specifications (Rotary Heads)

Motor to Spindle Housing.....	100 ft. lbs.
Spindle to Deck.....	425 ft. lbs.
Spindle to Adjusting Nut (Bearing Preload).....	25 in. lbs. Rolling Torque
Blade Bar Leaf Bolts Old Style 7/8" Bolts.....	600 ft. lbs.
New Style 1-1/4" Bolts.....	2000 ft. lbs.
Blade Bar to Spindle Bolts.....	400 ft. lbs.
Blade Bolts.....	400 ft. lbs.
Motor Plate.....	See Set Up Instructions

11. TORQUE VALUES - BOLTS: Recommended Torque, Ft. lbs. & (Nm)

IMPORTANT! Listed below IS BOLT TORQUE and NOT APPLICATION TORQUE, Component Application Torque will vary depending on what is bolted down and the type material (Metal) that is being bolted together. Thread condition and lubrication will vary Torque settings.

Inche Sizes

Bolt Dia. inch	2 (B) Plain Head	5 (D) 3 Dashes	8 (F) 6 Dashes
1/4	Not Used	10 (14)	14 (19)
5/16	Not Used	20 (27)	30 (41)
3/8	Not Used	35 (47)	50 (68)
7/16	35 (47)	55 (75)	80 (108)
1/2	55 (75)	85 (115)	120 (163)
9/16	75 (102)	130 (176)	175 (230)
5/8	105 (142)	170 (230)	240 (325)
3/4	185 (251)	300 (407)	425 (576)
7/8	160 (217)	445 (603)	685 (929)
1	250 (339)	670 (908)	1030 (1396)
1-1/8	330 (447)	910 (1234)	1460 (1979)
1-1/4	480 (651)	1250 (1695)	2060 (2793)

ALWAYS CHECK MARKINGS ON TOP OF BOLT HEAD OR OTHER BOLT DESCRIP-TIONS

Metric Sizes

Bolt Dia. mm	4.8	8.8	10.8
6	5	7	12
8	11	20	25
10	20	40	58
12	37	70	105
14	60	100	140
16	92	155	200
18	118	216	280
20	160	270	355
22	215	330	430
24	285	500	700
27	450	875	1000
30	600	1200	1700
33	800	1600	2300
36	900	2100	3000

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VALVE SECTION

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CONTROL VALVE - WIRING

(Used 1998 & Up)

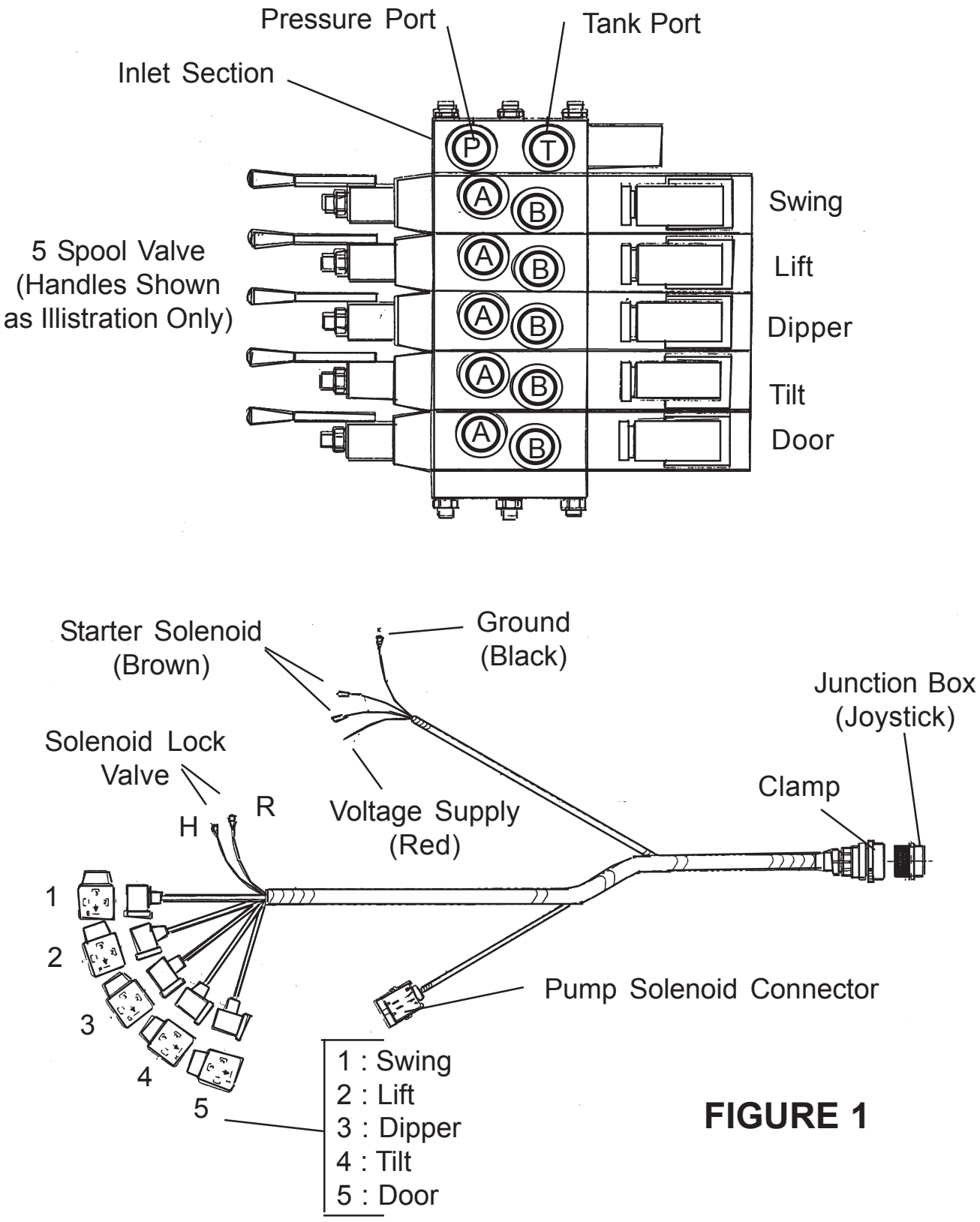

FIGURE 1

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CONTROL VALVE - OPERATION

HYDRAULIC FUNCTIONS:

The Hydraulic Functions of the Machete Boom Mower are controlled by a Pilot operated Electrically Actuated Control Valve.

GENERAL OPERATION:

This Section addresses the method of operation of the electrical part of controls. The function of the Hydraulic Valve itself will be covered in another Section. Three Functions, The Lift, The Dipper and the Swing are "Proportional" meaning that the Speed of operation can be slowed down or Sped up according to the position of the Joystick Control. The Door and Tilt Functions are "On" or "Off" only, Meaning that their speed of operation is dependent upon the volume of Oil Flowing through the Circuit and cannot be controlled by the Joystick position. In Our application the Oil Volume varies with the Tractor Engine Speed.

SPECIFIC OPERATION: (Figure 2)

The Electrical Power to operate the Circuits is obtained from a Switched and Fused Tractor Voltage Source. This means that the Electrical Power Wire to the Joystick Controller should only be connected to a Wire that has Voltage when the ignition is in the "On" Position. If Connection of the Joystick Controller is to a constant current source it will cause power drain on Battery and eventually Battery Failure. Furthermore the Master Switch on the Joystick Console (Figure 5) must be in the "On" position to allow for the operation of any of the Control Functions. To achieve Electrical Proportional Actuation, The main Spool Position is adjusted so that it corresponds to an Electrical signal sent from the Joystick Controller. The Position of the Joystick is Electrically sensed by a Coil and Magnet located in the Joystick Assembly which sends the positioning information to the electric controller in the Valve. The Signal from the Joystick is converted by the electronic Controller into Hydraulic Pressure by activating a series of Hydraulic Valves. These Valves direct the Standby or Pilot Pressure Oil to the proper end of the Spool to cause it to move. Likewise the position of the Spool is converted in the Spool position transducer to feedback signal. This Signal is registered by the electronic controller which will activate the series of valves as needed to move the spool in either direction until the spool is positioned in accordance with the location of the Joystick. An equilibrium between the Joystick and feedback signal is the end result.

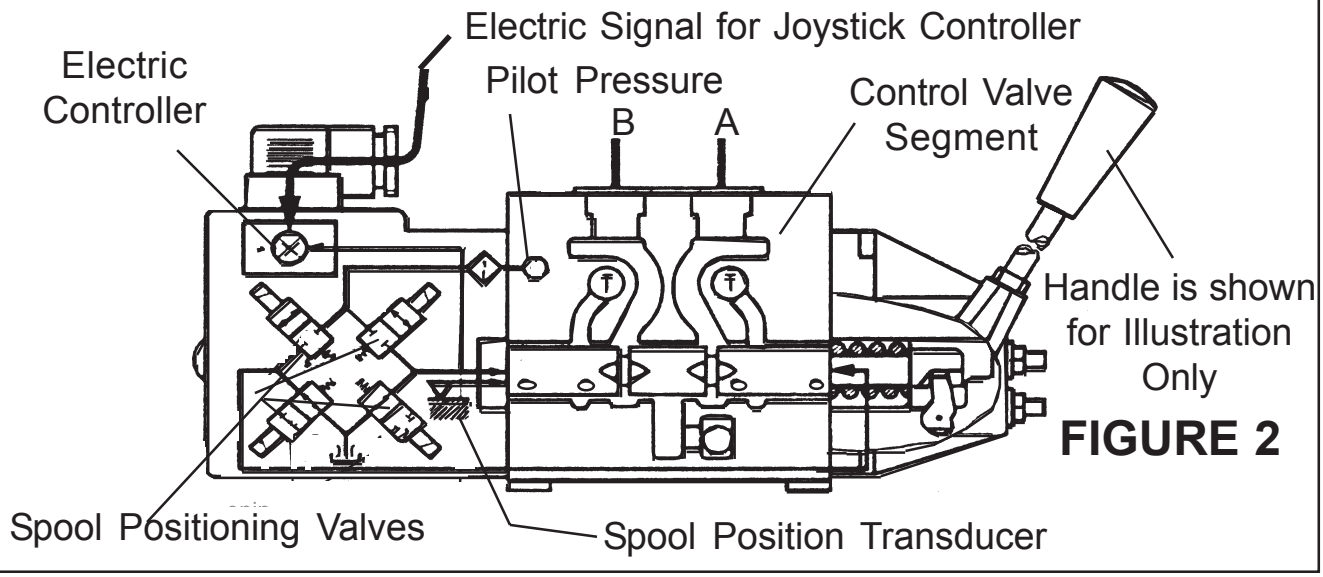

FIGURE 2

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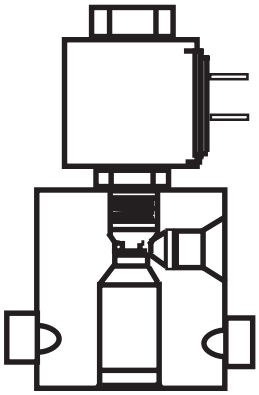
CONTROL VALVE - OPERATION

HYDRAULIC LOCK VALVE: (Head Tilt Function)

An Electric Solenoid Operated Hydraulic Lock Valve (Figure 3) is incorporated in the Head Tilt Function to prevent excessive (Head Lift Cylinder) leak down during storage or transportation. The Solenoid which operates this valve is normally in the Locked position until Head Lowering function is actuated at Joystick. When Joystick is actuated to lower Head an electric signal is sent to solenoid to open Lock valve. When the function to raise the Head is activated there is no electric signal from Joystick. The pressure against the valve when head is being raised will force Valve open like a relief Valve allowing Oil to pass through it. If this valve will not open it could stop head from lifting or dropping. The valve is plumbed into the Hydraulic Circuitry of the Head Tilt Function and is located near the Control Valve.



Hydraulic Lock Valve

FIGURE 3

ELECTRIC SIGNALS:

Electrical Signals are sent to the Controllers etc. through a Wiring Harness, The Harness is supplied with a one way connector at the Joystick Console Box (So it can not be installed Wrong). Connectors are supplied for each electric valve controller connection, These are labeled (with Letter code A,B,C etc.) for the function which they are connected. The Plug will only fit together one way and should always have right connections. BUT if the terminals within this Plug are moved around or the connections at the valve end are changed then the Plug would still be connected the same way and be Wrong. If any connections are removed they MUST be placed back in the same order they came out of. (SEE FIGURE 5 and 6) See Figure 6 for Plug Connection (Letter Code) & Terminal locations, Also the Wiring Schematic, BUT NOTE on the Wiring Schematic it WILL NOT be the actual location of Wires (Letter Codes ABC etc.), They are changed to enable the wiring diagram to be drawn with as few lines crossing each other as possible for illustration purposes.

See Figure 6 for actual Wire locations in Plug.

DO NOT USE WIRE SCHEMATIC PIN LOCATION IN PLUG TO MAKE CONECTIONS IN ACTUAL PLUG.

DO NOT CHANGE LOCATIONS OF PINS AND/OR WIRES IN PLUGS, THEY MUST BE CONNECTEDTHE SAME WHEN REPLACED OR THE SYSTEM WILL MALFUNCTION AND THIS COULD ALSO DAMAGE JOYSTICK CONTROLLER COMPONENTS.

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CONTROL VALVE - JOYSTICK

JOYSTICK FUNCTIONS: (Figure 4)

To operate a function the following series of events must work.

1. The Joystick Controller is moved in the correct direction the required distance, During its movement an electrical signal is sent to the electric Controller in the proper Valve Section of the Control Valve.

2. The Electric Controller sends an electrical signal, which causes the Proportional Control Valves to actuate the proper amount based on the signal from the Controller. EXAMPLE: Valves 1 & 3 allow Pilot Pressure Oil to flow to the corresponding end of the Spool, Thus causing it to move. Valves 2 & 4 allow the Oil from the opposite end of the Spool to return to the Tank. (NOTE: Lift, Swing and Dipper functions are Proportional, Door and Tilt functions are "ON" or "Off" Only, See later section for explanation of Proportional).

3. The Spool position Transducer sends an electrical signal to the Electronic Controller which indicates the position of the Spool.

4. The Electronic Controller will continue to adjust the Valves (1 - 4) in order to maintain an equilibrium between the Joystick signal and the feedback signal.

5. Reaction time from the time the Joystick is moved until the Spool moves is approximately 300 milliseconds.

6. The Rocker Type Switch on top of the Joystick is spring centered 3-function switch (Figure 4). When used alone the Rocker Switch controls the Head Tilt function, When used in conjunction with the Trigger Switch the Rocker Switch opens and closes the Door, Both of these functions are NOT controlled Proportionally. When the Toggle Switch is activated, The electrical signal fully opens either Valve 1 or 3 and fully closes either valve 2 or 4 in the correct Valve Section depending on which way the Spool needs to travel. The Electronic Controller and the Spool position Transducer are not included in these functions.

7. Earlier Model Joysticks Master Switch was a 2 Push/Pull Switch type. Later Models have one Push/Pull Switch with a Momentary Pull Start Switch built in to it and a Lighted Rocker Master Switch.

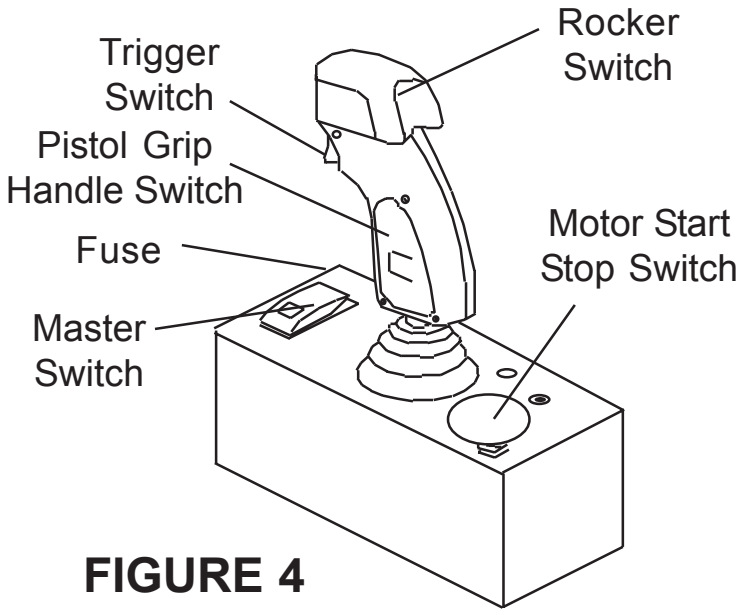

FIGURE 4

Joystick Functions

Rocker Switch Only

Push Right	=	Tilt Down
Push Left	=	Tilt Up

Rocker & Trigger Switch

Push Right	=	Door Close
Push Left	=	Door Open

Pistol Grip Handle Switch

Push Front	=	Lift Down
Pull Back	=	Lift Up
Push Right	=	Dipper Up
Push Left	=	Dipper Down
Rotate Right	=	Swing Out
Rotate Left	=	Swing In

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CONTROL VALVE - JOYSTICK

JOYSTICK TROUBLE SHOOTING:

The Joystick Wiring Harness has 2 wire connections to link Machete to Tractor Power Supply (12 Volt DC). One red colored wire (for Positive Connection) and 1 Black colored wire (for Ground Connection). These wires will provide power to start the Front Auxilary Pump that runs the Cutting Head Motor Circuit and power to operate the 5 spool Valve Electrical Circuits. The Hydraulics to operate 5 Spool valve is furnished from Tractor Hydraulic System through the Tractors Internal Hydraulics.

The Joystick Wiring Harness also has 2 other wires that must connect to Tractor; these are 2 Brown colored wires. These wires connect in to form the Safety Link in the Tractor Start Circuit to prevent the Tractor Engine from being started when the Machete Electrical Circuit is energized. These wires (Brown Colored) connect the Starter relay Circuit of the Tractor to the Master "On" / "Off" Switch (Rocker Switch on later models) on the Joystick Console of the Machete. Caution: These 2 wires (Brown Colored) are to be spliced into Tractor Starter Relay Wire (approximately 3 ") behind Starter Switch (normally Key Switch). DO NOT splice wires (Brown Colored) any further from Starter Switch than 3", if further than 3" it may cause electrical interference in other tractor electrical operations when the Motor Circuit is engaged.

With the Switch (Keyed Switch) of tractor in the "On" position and the Rocker Master Switch on Joystick Console in the "On" position a Green Light (on Master Switch) should be on. (Note: Early models did not have a Lighted Master Switch only a Push / Pull Switch). This green light indicates that electrical power is available to the five movement control circuits of the Valve, and to the start system of front pump as well as start circuit of Motor. To Check this Current at Switch (Master or Motor Stop Start Switch) it can be done with a test light or Voltmeter.

VALVE CONTROLS CONNECTION TROUBLE SHOOTING:

1. **Proportional Controlled Functions,** Only the Swing, Lift and Dipper Functions are Proportional Controlled, Therefore only these three functions will show progressive readings. The Tilt and Door Functions are "On" or "Off, when checking keep track of which connection is being check, as it will make a difference in reading on voltmeter
2. **All Connections are marked on plug** where they plug onto Valve (See Figure 5)
3. Make sure Tractor Engine is off and cannot be started while you are working on it.
4. **Relieve Any Hydraulic Pressure,** Make sure any Hydraulic Pressure in any Lines or Cylinders has been relieved and Mower / Boom are resting on the Ground completely. This should be done by working the Manual Overrides on Valve to be sure pressures are relieved.
5. Turn on Ignition Switch of Tractor to the "On" position (But DO NOT Start Engine)
6. Switch on the Master Rocker Switch (Push / Pull on older models) to the "On" position.
7. **Remove the "Din" connector** from the control Valve Section being tested to check voltage.
8. The Spade type Pins will be on the Section of the Valve and the plug will have slots where it plugs on, Each of these connectors have numbers at the slot to ID which connections (see Figure 5) connect where, these plugs cannot be reversed, will only plug on one way.
9. **Voltage from the No. 1 Slot**, Positive (12 Volt DC), Voltage will depend on Battery condition, it cannot exceed the amount of the voltage in the battery and should not be less than Battery Voltage when Joystick Switch is activated, So always Know what voltage is in Battery. (See Figure 5)

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CONTROL VALVE - JOYSTICK

JOYSTICK TROUBLE SHOOTING:

VALVE CONTROLS CONNECTION TROUBLE SHOOTING: (Continued)

10. **Voltage from the NO. 2 Slot,** Positive (12 Volt DC) Voltage should be 1/2 of what reading at Slot No. 1 is. With Voltmeter connected to the No. 2 Slot of Plug and the Joystick in Neutral (Centered) position begins moving Joystick and watch Voltmeter, (be sure you are moving Joystick to Match functions being checked). The Voltage should rise as Proportional to the movement of Joystick (Proportional Sections Only) and "on" or "off" on sections without proportional functions. (See Figure 5)

11. **Tilt Function,** The Tilt Section incorporates a 'Lock Out Solenoid" on the down function side that operates on 12 Volts, See previous page (Figure 3) for this Lock Out Solenoid Valve

12. **Emergency Field Test,** Can be performed without a Voltage Meter, But it is always best to use a Voltmeter for electrical testing. NEVER use an extra 12 Volt hot wire to supply current to connections for testing Valve or Joystick connections or components as it would damage components.

Emergency Field Test, if in a remote location and you do not have a Volt Meter, You can test the Joystick and Harness by temporally relocating (swapping) the plugs on the Valve to make another action performs a different function. This will tell if the problem is in Joystick or connections. Also in an emergency situation this method could be performed to get unit in transport position or use method in next step. Note: be sure to move any swapped connection back to their original location when diagnosing a problem.

13. **Mechanical Valve Test, This** test will tell if problem is in Valve or electrical Circuit. This can also be used to put unit in a transport position or to move unit in emergency situations. There is a manual override on the valve that will allow you to move the Components (Boom, Head & Etc.) Manually. **Follow the following steps.**

- **A.** Use extreme caution while performing this operation, Know where every one around you are at all the time! DO NOT do this if you are not experienced with the functions of unit, Go back and learn Functions.
- **B.** Shut Tractor Engine Off.
- **C.** Turn "Off" Master Switch on Joystick Console, This will turn off all electric function including Front Hydraulic Motor.
- **D.** Make sure no one is near Tractor, Boom or Head.
- **E.** Locate Control Valve, It will be mounted on Side Rail of earlier models or in Front at Front Pump on later models.
- **F.** Remove all covers required to gain access to Valve.
- **G.** Restart Tractor Engine (DO NOT Turn on Joystick Console Master Switch).
- **H.** Go to Valve and look for a Hex Bolt Head sticking out of each valve section on the opposite side of valve from the electrical connection at Valve. Older Models this was a 1/2" Wrench size (old style "Apitech" Valve with 10 Plugs at Valve, 5 plugs on each side of Valve) and on the later models it is a 9 mm Wrench size (later Valve has 5 Plug at Valve, all 5 are on 1 side of Valve).
- **I.** Using Wrench as a Handle move Wrench to activate Valve section needed to move component you want to move, Then go on to the next Valve section and move it.

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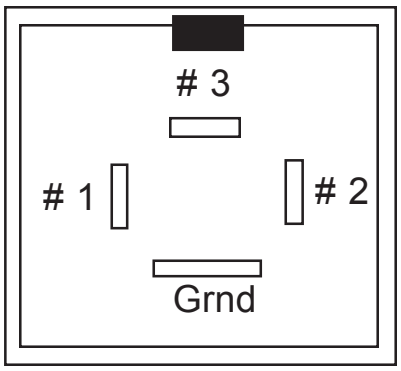
CONTROL VALVE - JOYSTICK PLUG



Numbered Slots on "DIN" Plugs at Valve (5) (Only On Units with 5 Plug Harness, Late Model)

# 1	=	Positive, 12 Volts DC
# 2	=	Positive, Should be 1/2 of voltage of # 1
# 3	=	This Slot is not used in this application
Grnd	=	Negative, Common Ground (long Slot)

FIGURE 5

PIN PATTERN OF HARNESS PLUG & PLUG AT JOYSTICK CONSOLE

Below (Figure 6) is ths actual Pattern of Pins in Plug at Joystick Console and the Pattern for plug on Wiring Harness. In Wire schematic drawing this Pattern is the same for Illustration of Wire Routing, Some Wires cross each other in illustration but actualy run along side each other in actual Harness. In the illustrations notice some pins are connected together . Use Plug patterns in Wire Schematic to Connect plugs is OK.

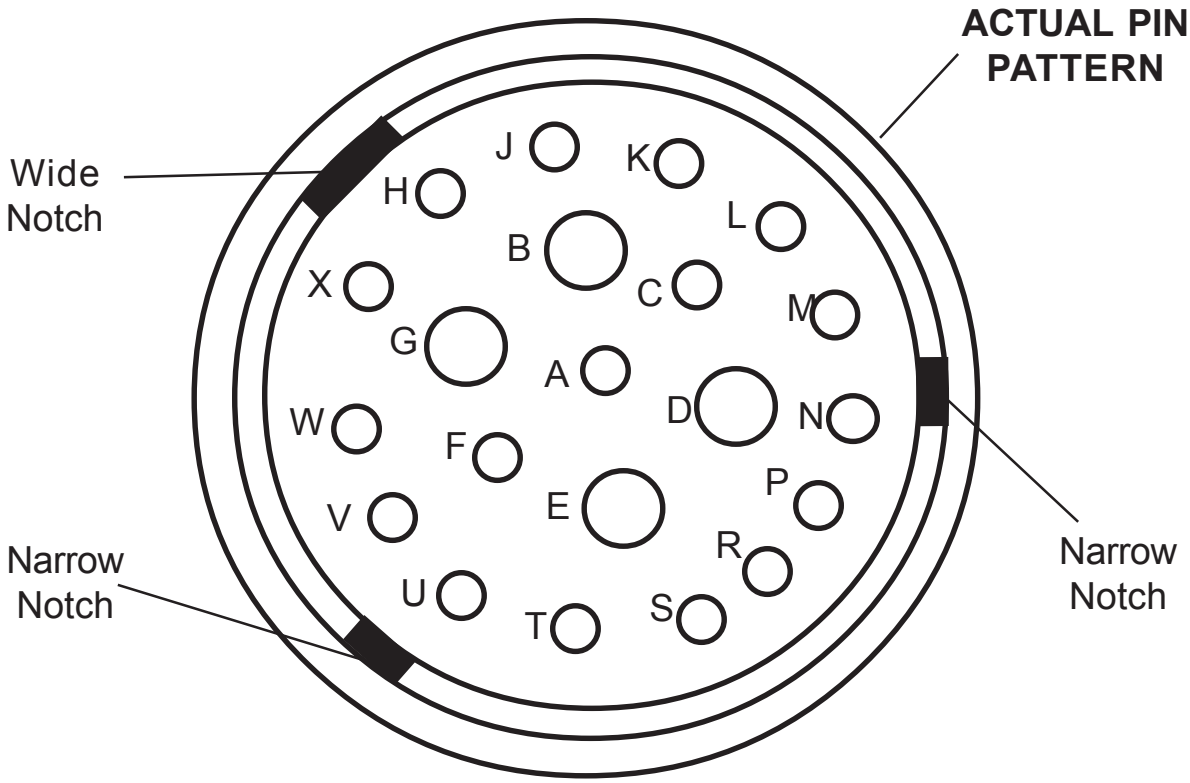


FIGURE 6

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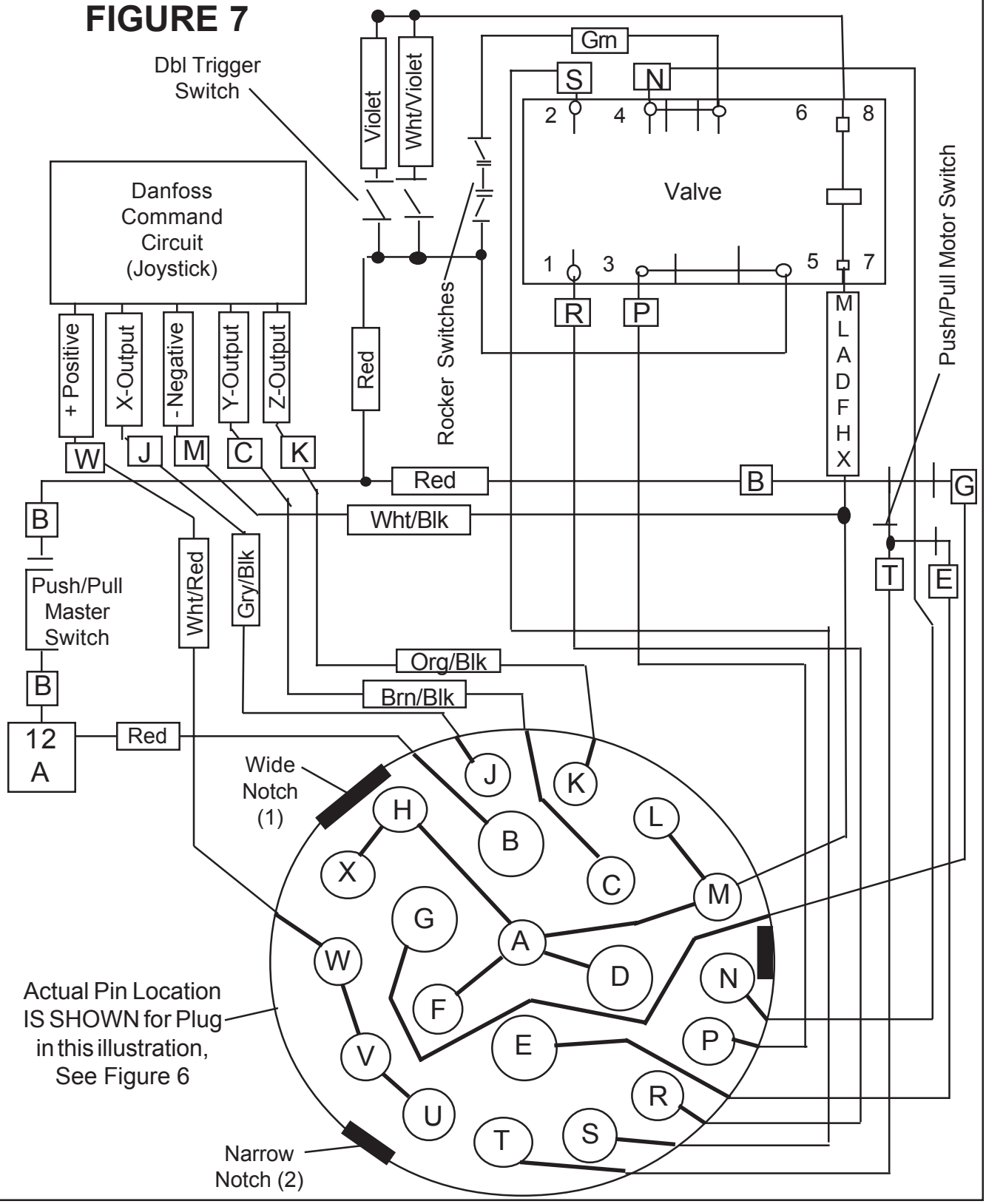
CONTROL VALVE - JOYSTICK PLUG

Joystick Console Plug (Old Style) w/2 Push / Pull Switches

FIGURE 7



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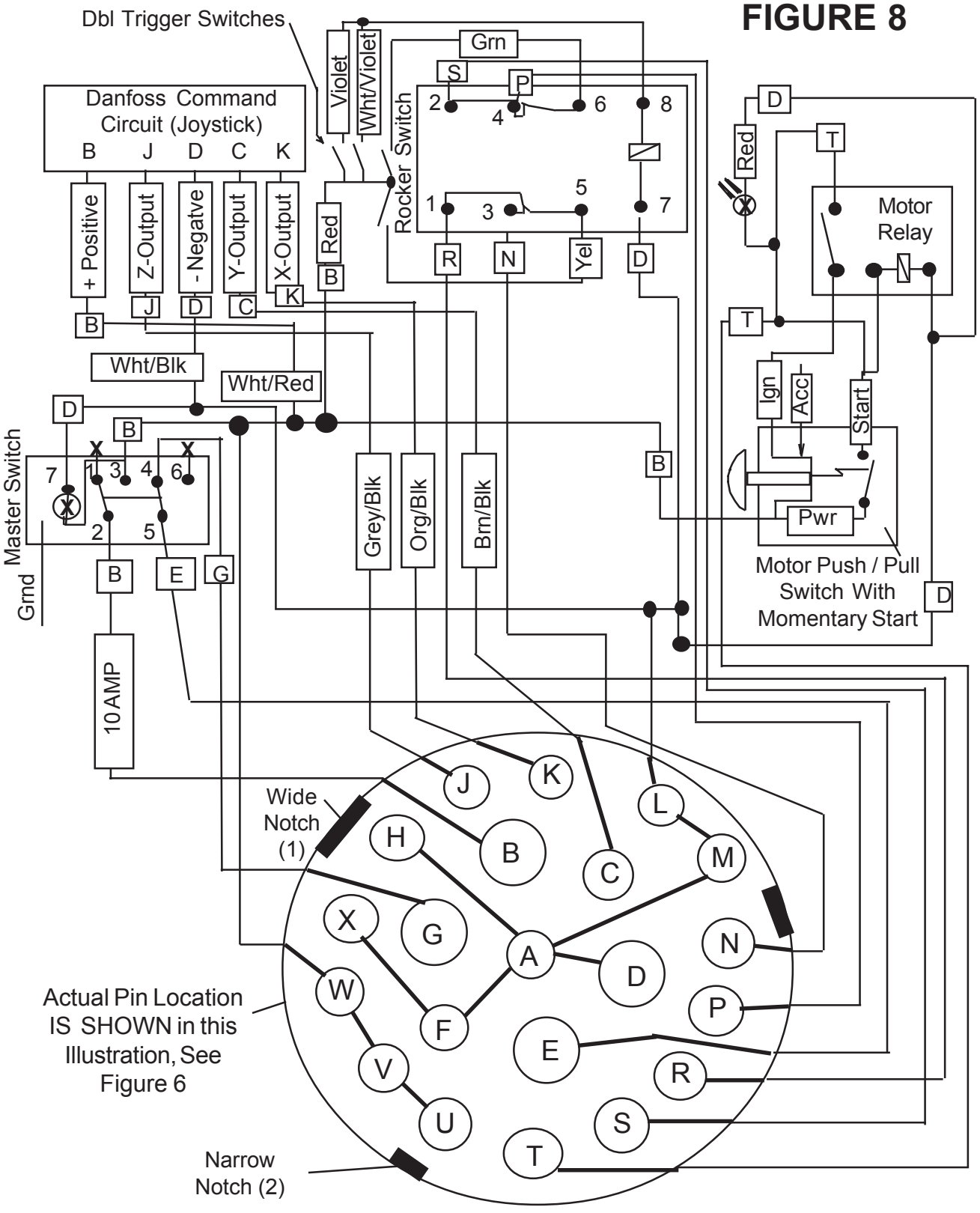
CONTROL VALVE - JOYSTICK PLUG

Joystick (New Style) w/ Push/Pull Motor Switch & Rocker Master Switch

FIGURE 8



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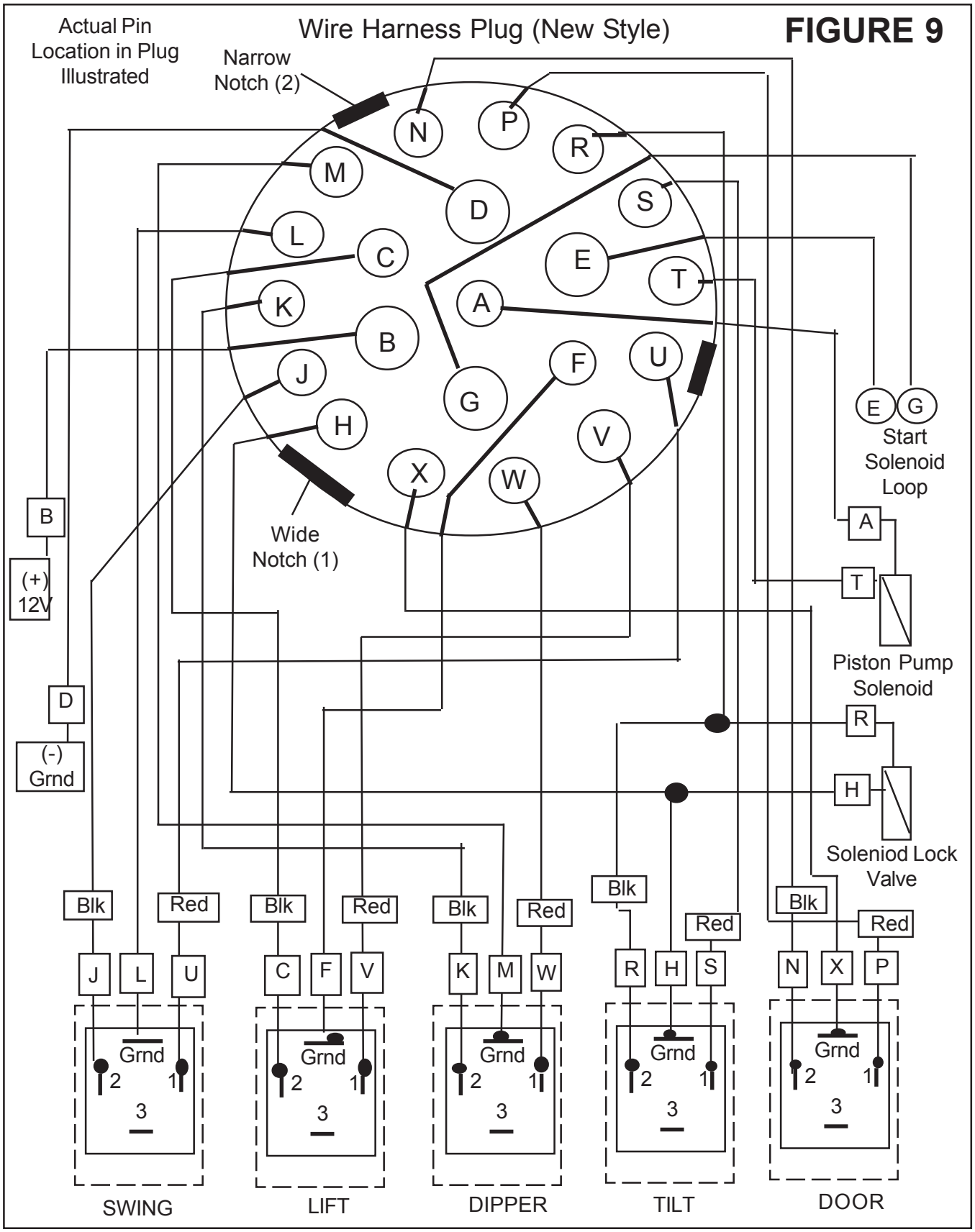
CONTROL VALVE - WIRE HARNESS PLUG



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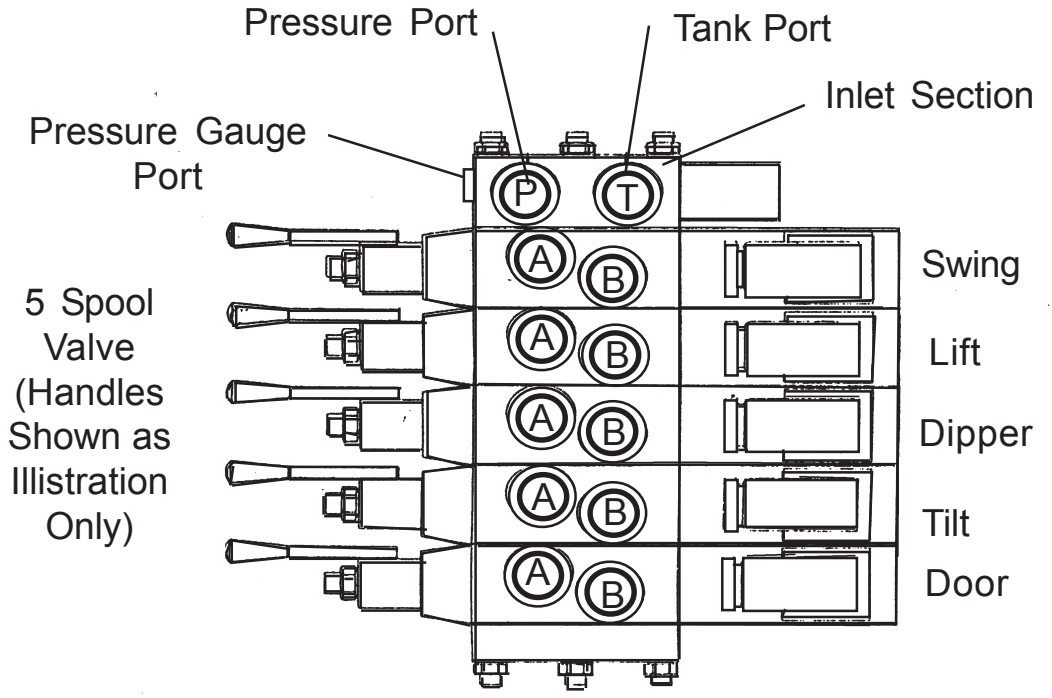
CONTROL VALVE - HYDRAULIC

CONTROL VALVES: (See Figure 10)

The Alamo Machete Hydraulic Control Valve is an Electro-Hydraulic (Electric over Hydraulic) Valve. The Valve is designed to utilize Oil from the Tractors Hydraulic System. This is basically considered a Selector Valve. Since the Tractor System is the Source of Hydraulic Supply (Hydraulic Pressure). The Hydraulic Control Valve must be compatible with the type Tractor System being utilized. There are two types of Tractor Hydraulic System available to be used (Note: in some cases even these two type systems can vary from Tractor to Tractor Model, and make connections different. See original Mount Kit Instruction for Connecting Hydraulic Supply from Tractor to Valve).

Type 1. Load Sensing (Closed Center) Constant Pressure with Flow on demand.
Type 2. Fixed Displacement (Open Center) Continuos Flow with Pressure on demand

Valve Shown Below use 1998 & Up, it has 5 Plugs on Wire Harness that plug onto Valve. Old Style Valve used 1997 & Down had 10 Plugs on wire Harness, 5 on each side of Valve. Also the late Model has an added Filter Assembly (P/N 02976066) which was added to protect Valve from contamination from Tractor Hydraulic System. This is a Spin on type Filter.



(This Valve Used 1998 & Up)

FIGURE 10

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CONTROL VALVE - HYDRAULIC

CONTROL VALVE COMPONENTS: Fixed Displacement Valve End Cap

The Control Valve for Both Type Systems (Load Sense or Fixed Displacement) consists of the same basic components. The Difference between the Control Valves for the two systems involves the components in the Inlet Section. The Inlet Section (End Cap) of the Fixed Displacement (Open Center) Valve (Figure 11) contains the following components.

1. Pressure Bypass Adjustment Spool
2. Pilot Reducing Valve
3. Pressure Relief Valve
4. Load Sense Passage Plug

FIXED DISPLACEMENT VALVE END CAP

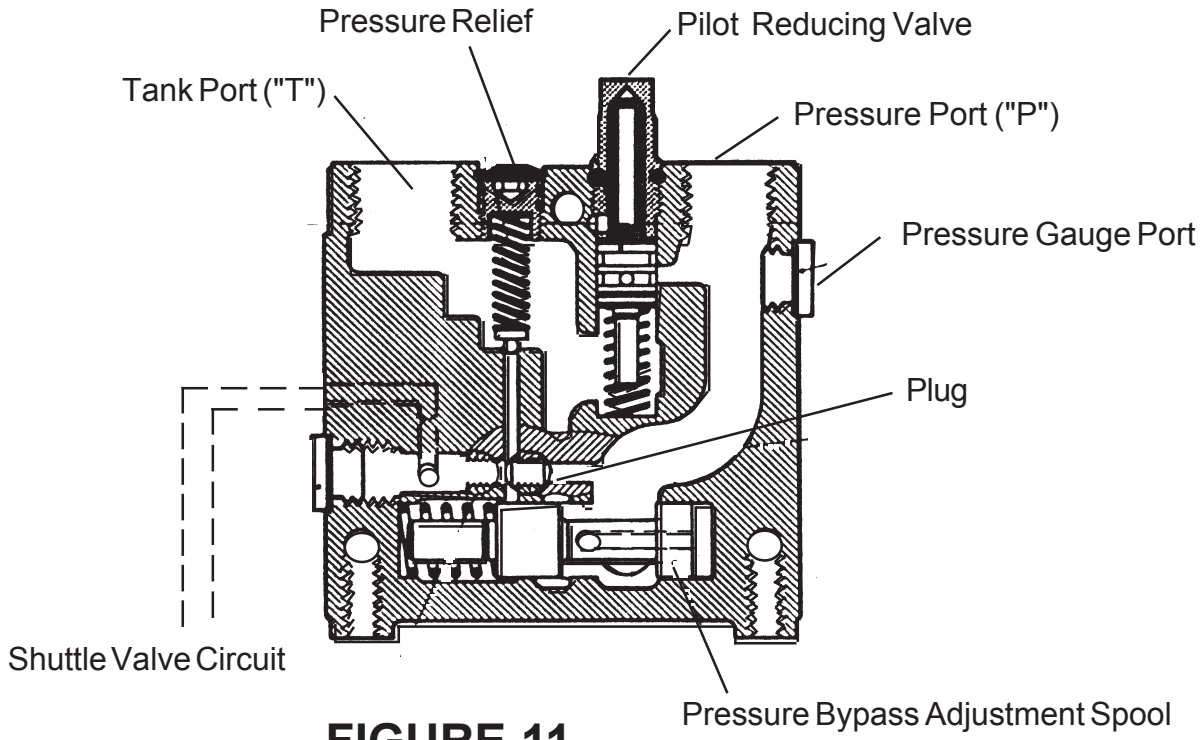

FIGURE 11

When the Tractor is Started and the Main Spool in the 5 Sections of the Control Valve are in The Neutral (Centered) Position, Oil Flows from the Pump, Through connection “P” across the pressure bypass adjustment spool to the Tank. The Oil Flow which is led across the Pressure Bypass Adjustment Spool determines the Pump Pressure. (Pump Pressure at the Neutral Position will be equal to Standby Pressure).

When one or more of the Main Spools are activated, the Load Pressure is fed through the Shuttle (or Load Sense) Valve Circuit to the Spring Chamber behind the Pressure Bypass Adjustment Spool. This completely or partially closes the connection to Tank; This allows Oil Pressure to flow to Cylinders when needed.

The Pilot Reducing Valve maintains Standby (Pilot) Oil Pressure to the Proportional Control System (200 to 250 PSI)

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CONTROL VALVE COMPONENTS: Load Sensing Valve End Cap

The Control Valve for Both Type Systems (Load Sense or Fixed Displacement) consists of the same basic components. The Difference between the Control Valves for the two systems involves the components in the Inlet Section. The Inlet Section (End Cap) of the Load Sensing (Closed Center) Valve (Figure 12) contains the following components.

1. Pressure Bypass Adjustment Spool
2. Pilot Reducing Valve
3. Pressure Relief Valve
4. Load Sense Passage Outer Plug
5. Load Sense Orifice

LOAD SENSING VALVE END CAP

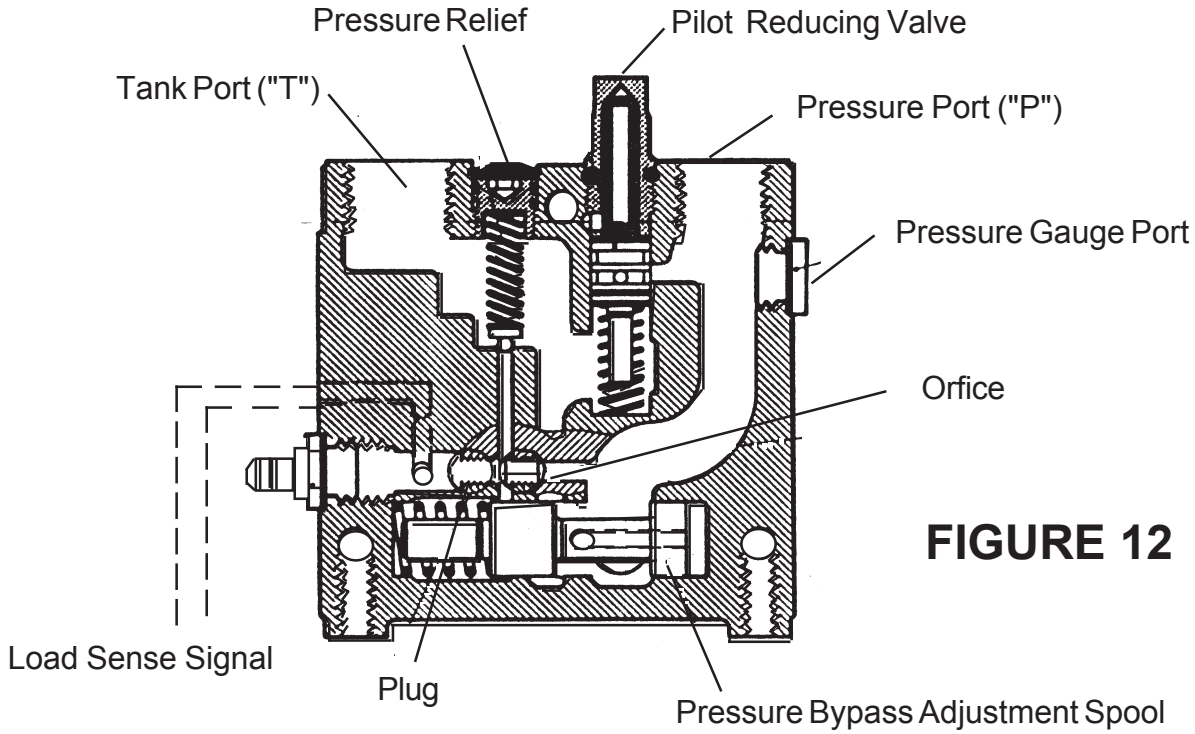

FIGURE 12

The Load Sensing Valve (Closed Center) Version, An Orifice with an Outer Plug are used in place of the Plug which was used in the Fixed Displacement (Open Center) Version. Therefore the Pressure Adjustment Spool will only open to Tank when the Pressure in the Pressure Port “P” exceeds the value of the Pressure relief.

The Load Sense Signal or Load Pressure is led to the Tractor Pump Regulator via the Load Sense Connection.

In the Neutral Position the Pump Control sets the Displacement so that leakage in the system is compensated for and the Standby (Pilot) Pressure is maintained (approx. 200 to 250 PSI).

When a Main Spool is activated, The Pump Regulator will adjust the displacement so that the set differential pressure between the Pressure Port “P” and the Load Sense Signal pressure is maintained.

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CONTROL VALVE - HYDRAULIC

CONTROL VALVE COMPONENTS: Valve Section Components

Each of the 5 Valve Sections (Figure 13 & 14) contains the following Components. Note: Handles shown in Figure 13 & 14 are not on Valves, They are shown as Illustration Only, On Actual Valve Section there will be a Hex Head sticking out here, 1/2" Wrench for older Valves (10 Plug Harness) and a 9 mm Wrench for later Valves (5 Plug Harness). The Later Style Valve (5 Plug) Shown in Figure 13.

1. Segment Compensating Spool
2. Anti-Cavitation Check / Work Port Relief Valve
3. Manual Over Ride Control
4. Mechanical Flow Limiters
5. Main Flow Control Spool
6. Shuttle valve

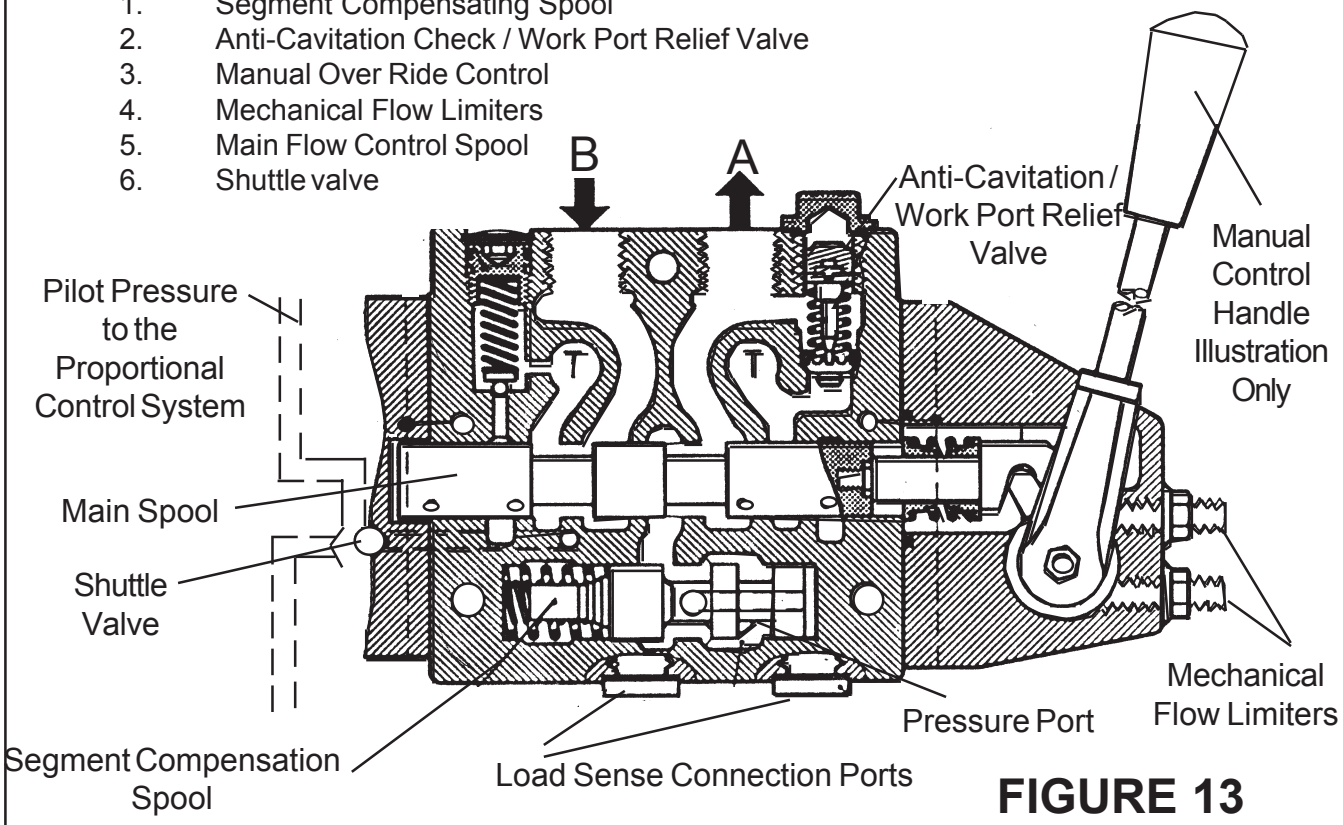

FIGURE 13

SEGMENT COPENSATING SPOOL, Pressurized Oil must pass by the segment Pressure Compensating Spool before it is used by the Cylinders. The Compensating Spool uses Load Sense and Spring Pressure to maintain constant pressure drop across the Main spool, Both when the Load changes and when a Segment with a higher load pressure is activated.

Anti-Cavitation Check / Work Port Relief Valves, Work Port Relief Valves are installed in the Swing, Lift and Dipper Circuits to limit the max pressure in those particular circuits to a lower pressure than the Main System Relief. The Anti-Cavitation Check Valve allows Oil to be taken from the return (Tank "T" Port) galley of the Valve when needed to prevent Cavitation of Cylinder. The Tilt and Door Valve Sections do not contain these valves.

Main Flow Control Spools, The Flow Control Spools work in conjunction with the Valve Body to direct the flow of Oil to the Cylinders. The spool is actuated by Pilot Oil Pressure, which is controlled by the Proportional Control System. It can also be Mechanically operated with the use of an external Lever or Wrench. Spools cannot be interchanged in the Valve Section due to the special individual designs of Spools. Maximum Stroke Adjusters are pre-set at the factory and will not need Adjusting.

Load Sense Shuttle Valve, The Load Sense Shuttle Valve located in each Section insures that the Load Sense Signal from the Valve Section with the highest Pressure is sent through the Load sense Line.

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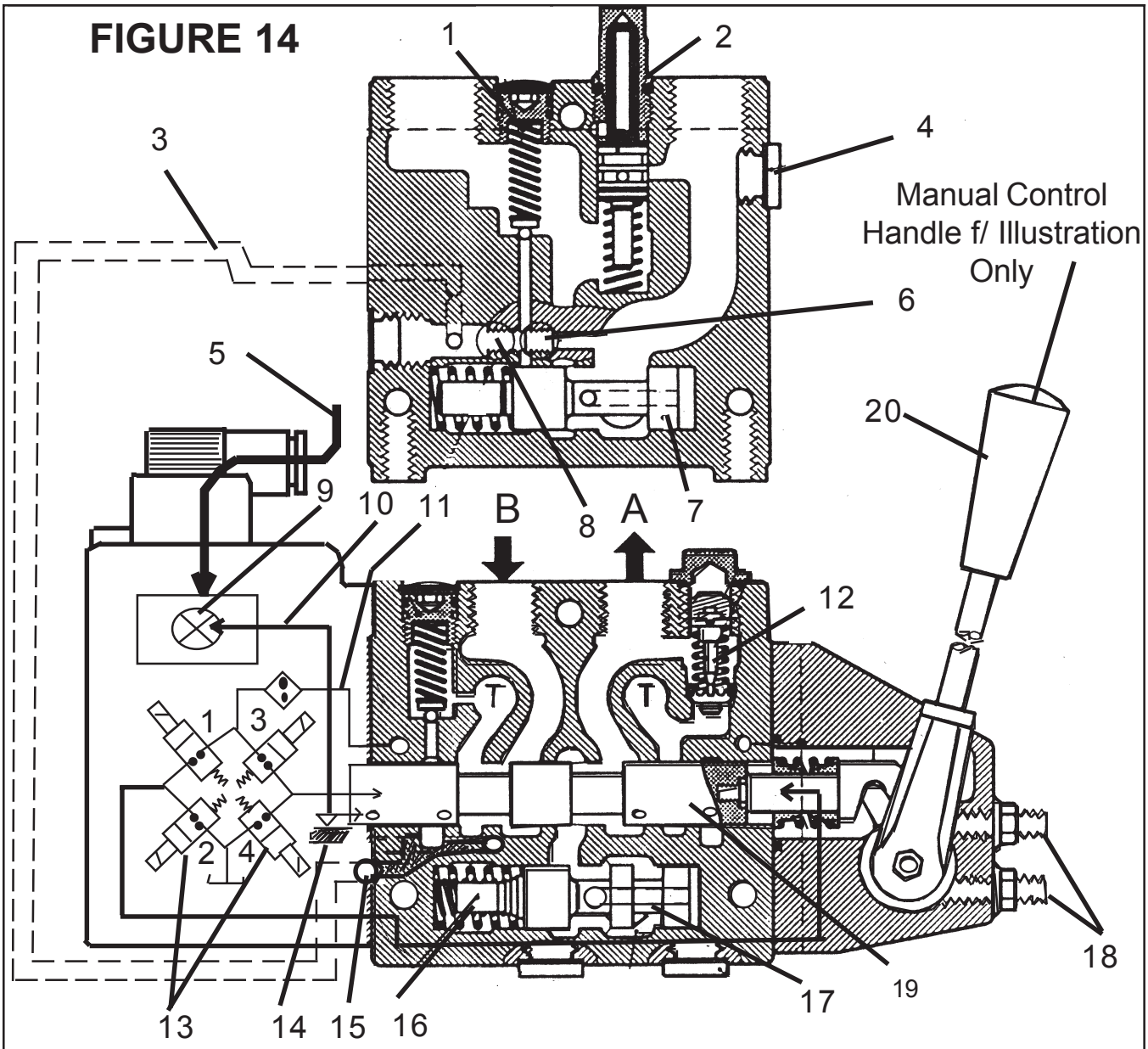
CONTROL VALVE - HYDRAULIC

FIGURE 14



Item	Description
1	Pressure Relief
2	Pilot Reducing Valve
3	Load Sense signal
4	Pressure Gauge Port
5	Signal From Joystick
6	Orfice = Closed Center Plug = Open Center
7	Pressure Bypass Adjustment Spool
8	Plug
9	Electric Controller
10	Spool Position Signal

Item	Description
11	Pilot Pressure Flow
12	Anti-Cavitaion / Work Port Relief Valve
13	Pilot Pressure Control valve
14	Main Spool Position Transducer
15	Shuttle valve
16	Segment Compenstaion Spool
17	Pressure Port
18	Mechanical Flow Limiters
19	Main Spool
20	Manual Control Handle (illustration Only)

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CONTROL VALVE - LOAD SENSING

GENERAL INFORMATION: Load Sensing Valve

The “Load Sensing” (Closed Centered) Systems are Commonly used on Tractors that may employ either Fixed Displacement or Variable Displacement Pumps.

The Load Sense Feature may control Pump Output or in the case of the Fixed Displacement Pump, Simply control delivery to the control Valve returning surplus Oil to the tank.

The Goal of either System is to reduce wasted energy, wear and tear from pumping Oil under Pressure when there is no demand on the system.

For the Purposes of this Manual, A Load Sense System will be defined as any system that varies the Flow of Oil to Control Valve based on a demand signal sent through a separate Load Sense Circuit, Closed Center System may or may not be load sensing systems.

ENGINE RUNNING AND ALL FLOW CONTROL VALVES CENTERED: (See Figure 15)

Oil from the Pump enters the Control Valve at the “P” (Pressure) Port on the Inlet Section (End Cap) and is available at each Flow Control Spool, The Pilot Reducing Cartridge and the Main Relief Valve. Oil flow is blocked by the Flow Control Spools, The Proportional Control System Valves and the Main Relief Valves.

Pressure at Neutral will normally be referred to a “Standby Pressure” and will be at least 200 to 250 PSI in order to maintain Pilot Pressure. Oil passes through the Pilot Reducing Cartridge and is blocked at each Proportional Control Valve. The Pilot Reducing Valve maintains 200 to 250 PSI in the Pilot Circuit.

The Main Relief is located in the Inlet Section (End Cap) of the Valve and limits the Pressure in the “P” Port to a maximum 2700 PSI.

The Load Sense Circuit is connected to the Return “T” Circuit when all Spools are in the Neutral (centered) Position.

With the Flow Control spools in their Neutral (centered) position, Oil Flows to and from the Cylinder is blocked by the Spool. The centering of the Spool connects the Load Sense circuit to the Return “T” Galley in the Control Valve. Since there is no Load Sense Signal being sent to the Pump, The Pump only delivers enough Oil to maintain Pilot Pressure.

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CONTROL VALVE - LOAD SENSING

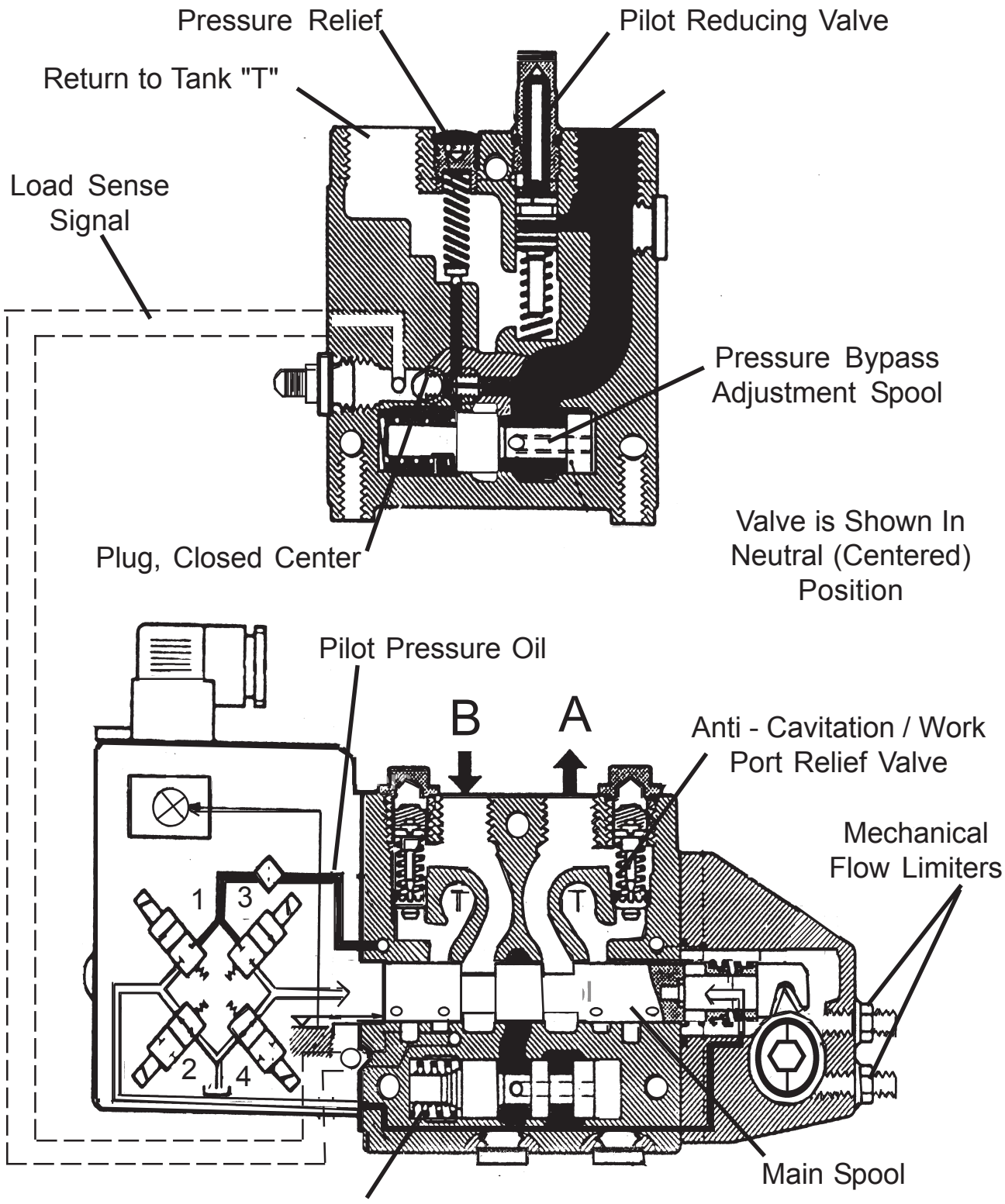

FIGURE 15

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CONTROL VALVE - LOAD SENSING

ENGINE RUNNING AND VALVE FUNCTION ACTIVATED: (See Figure 16)

When a function is selected and actuated by the controller, The Proportional Control System directs the Pilot Pressure Oil to move the Main Spool in its bore. Two actions resulting from the Main Spool Shifting in its bore now takes place. The Shifting of the Spool opens a passage to connect one end of the selected Cylinder to Pressure ("P") Galley and connect the other end to the Return ("T") Galley. The Shifting Spool also connects the Load Sense Circuit to the Pressure ("P") Circuit. The Pressure Signal is sent to the Pump Control System, which increases the Oil Flow to the Control valve. **The Pressure present in the ("P") circuit and the Load Sense Circuit is the same and is created by the Load on the Cylinder. (NOTE: The Load Sense Signal Shown in Figure 16 is an internal passage in Valve, it is shown here on the outside for illustration onlr and cannot be seen if actually looking at valve).**

Before the Pressurized Oil reaches the Flow Control Spool, it must first pass through the Segment Compensation Spool. The Compensating Spool uses Load Sense and Spring Pressure to maintain constant pressure drop across the Main spool, Both when the Load changes and when a Segment with a higher load pressure is activated.

The maximum Pressure in the Swing, Lift and Dipper Circuits is controlled by the settings of the Work Port Relief Valves of these Circuits. These Settings may be different for opposite ends of the same Cylinder or Circuit. The Cartridge also incorporates Anti - Cavitation Check Valves to provide make up Oil if required. These Valves will open to allow Oil from the Tank Galley to enter the Cylinder whenever there is no more Oil being demanded by a Cylinder than is supplied (Such as with the Lowering Function) in order to prevent Cavitation.

Proportional Control of the Lift, Dipper and Swing Functions is achieved through the Proportional Control System of each Section (Tilt and Door Functions DO NOT have Proportional Control, they are "Open" or "Closed" only). When an Electrical Signal is sent from the Joystick to the Electric Controller in the Valve, The Pilot Pressured Oil is then allowed to flow to either end of the Spool thus causing it to shift. The amount Pilot Pressured Oil to either end of Spool is varied with the Pilot Oil Control Valve by the Electric Controller there by controlling the distance the Spool Shifts. This in turn controls the volume of Oil sent to the Cylinders and consequently, the speed of actuation of the Cylinders.

The Tilt and Door Functions (While not Proportionally Controlled) are controlled by Pilot Oil Control Valves. However instead of opening or closing based on the Joystick position, these valves will fully Open (or Close) when activated.

When the Function is returned to Neutral at the Joystick, The electrical current to the Valve Controller is stopped. Therefore the Pilot Oil Control Valves return to their normal positions and the flow of Pilot Pressure Oil to the Main Spool is stopped. The Springs on the Main Spool returns the Spool to its Neutral (Centered) position. When the Spool is centered, The Load Sense Circuit is connected to the Tank ("T") Galley. With no Load Sense Signal, Pump returns to minimum.

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CONTROL VALVE - LOAD SENSING

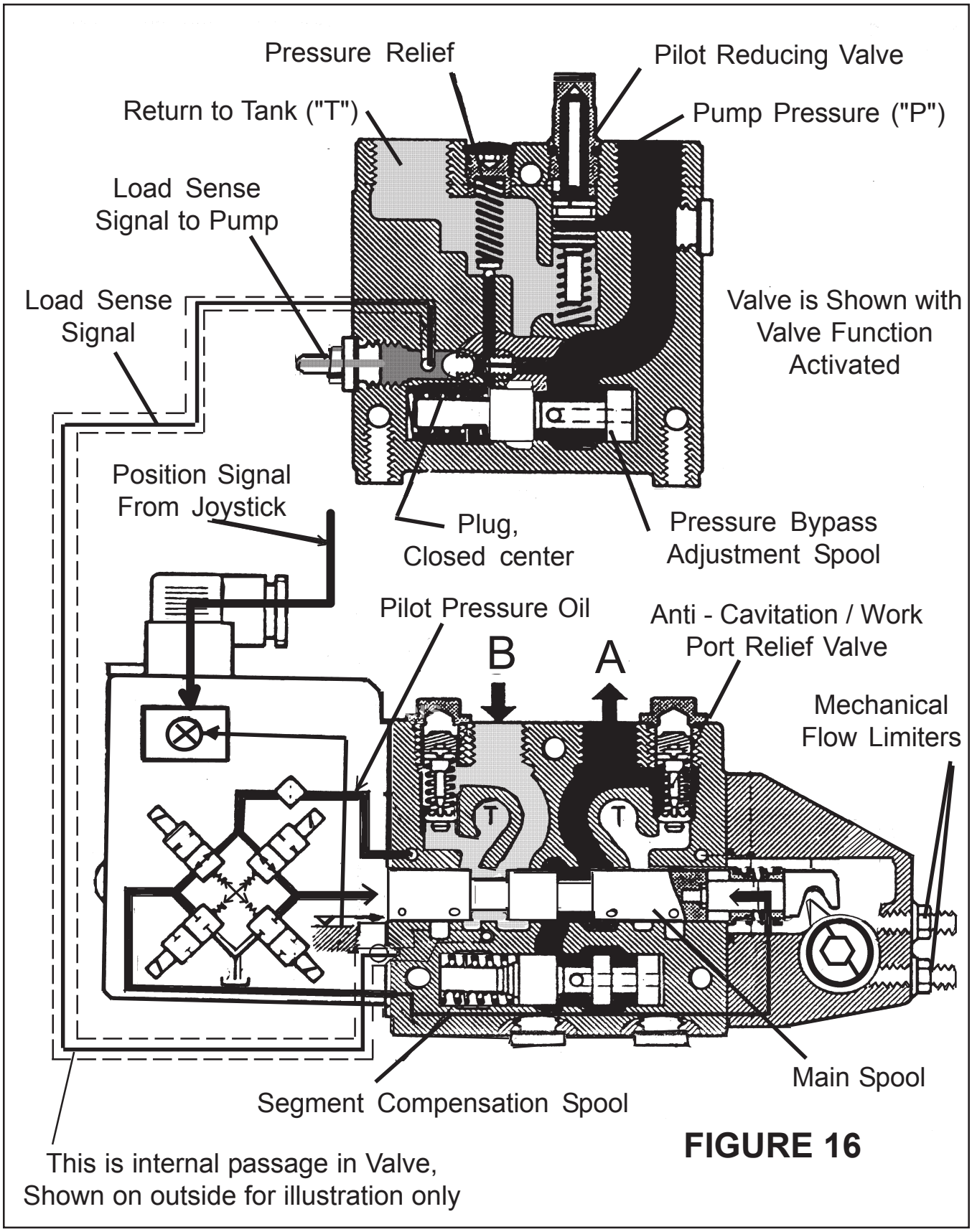

FIGURE 16

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CONTROL VALVE - FIXED DISPLACEMENT

GENERAL INFORMATION: Fixed Displacement Valve

The “Fixed Displacement” (Open Centered) Systems Control Valve is designed to be used on tractors that DO NOT have Load Sense (Closed Centered) Hydraulic Systems.

ENGINE RUNNING AND ALL FLOW CONTROL VALVES CENTERED: (See Figure 17)

Oil from the Pump enters the Control Valve at the “P” (Pressure) Port on the Inlet Section (End Cap), If there are no other Hydraulic functions being used; all of the flow from the Fixed Displacement Pump must go through the Control Valve. The Flow of Oil is blocked by the Flow Control Spools in each Valve Section, The Main Relief Valve, The Proportional Control System valves, The Load Sense Passage Plug and the Bypass Adjustment Valve. The first Circuit to be charged is the Pilot Circuit, Oil passes through the Pilot Reducing Cartridge which limits the Pressure in the Circuit to approximately 200 PSI.

After the Pilot Circuit is charged, Additional Oil being pumped into the Valve increases the pressure in the pressure (“P”) Circuit. When in Neutral, The Pressure in the pressure (“P”) Circuit is limited to approximately 215 PSI by the Pressure Bypass Adjustment Valve Spring. When the Pressure in the (“P”) circuit is enough to overcome the force of the Bypass Spring, the Bypass Spool is shifted in its bore, Opening a passage between the Pump Oil (“P”) Circuit and the Return (“T”) Circuit. The Bypass Spool maintains enough pressure (Pilot Pressure) in the System to actuate the Flow Control Spools and returns any surplus Oil to Tank.

When the Flow Control Spools are centered (Neutral), the Load Sense Passage works in conjunction with the Bypass Spring to limit the Main System Pressure in Circuit (“P”). Since there is no pressure in the Load Sense Passage in Neutral (Centered) the force of the Spring is the only factor determining System Pressure.

NOTE: The Load Sense Passage shown in figure 17 is an internal passage inside of Valve and cannot be seen if looking at Valve, It is shown here outside Valve as Illustration Only.

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CONTROL VALVE - FIXED DISPLACEMENT

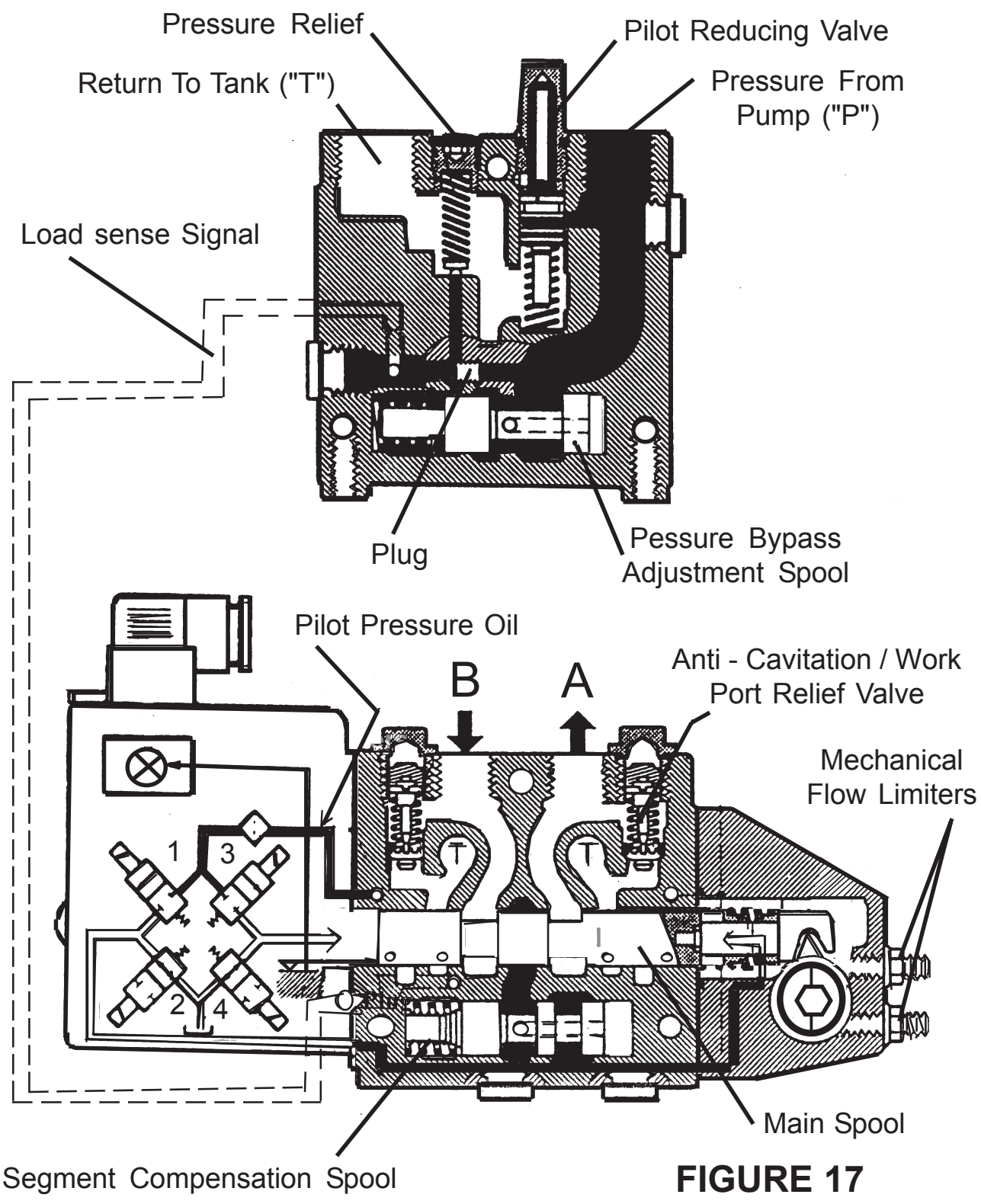

FIGURE 17

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ENGINE RUNNING AND VALVE FUNCTION ACTIVATED: (See Figure 18)

When a function is selected and actuated by the Controller, The Proportional Control System directs the Pilot Pressure Oil to move the Main Spool in its bore. Two actions resulting from the Main Spool Shifting in its bore now take place. The Shifting Spool opens a Passage to connect one end of the selected Cylinder to the Pressure ("P) Galley and connect the other end to the Return ("T") Galley. The Shifting Spool also allows the Load Signal created by gravity acting on the Cylinder to connect to the Spring end of the Pressure Bypass Adjusting Spool. This acts with the Spools spring to close the Passage to the Tank ("T"), and allows the correct amount of Oil to travel to the Cylinders. Based on the Load Sense Pressure, The Pressure Bypass Adjustment Spool will allow only the Oil needed at the Cylinder in accordance with the Controllers Position. Any excess Oil will be allowed to return to Tank ("T"). The Pressure present in the ("P") Circuit and the Load Sense Circuit is the same and is created by the Load on the Cylinder.

Before the Pressurized Oil reaches the Flow Control Main Spool, It must first pass through the Segment Compensation Spool, this Spool maintains a constant pressure differential (Flow) between the Supply Pressure and the Cylinder Pressure at the Flow Control Main Spool. (Simple Explanation: Function of Segment Spool is to keep a constant even pressure to Main Spool so Cylinder cannot suck in Air).

The maximum Pressure in the Swing, Lift and Dipper Circuits is controlled by the settings of the Work Port Relief Valves for these Circuits. These settings may be different for opposite ends of the same Cylinder or Circuit. The Cartridge also incorporate Anti - Cavitation Check Valves to provide make up Oil if required. These Valves will open to allow Oil from the tank Galley to enter the Cylinder when ever there is no more Oil being demanded by a Cylinder than is supplied (Such as with Lowering function) in order to prevent Cavitation.

Proportional Control of the Lift, Dipper and Swing Functions is achieved through the Proportional Control System of each section. When an electrical signal is sent from the Joystick to the Electric Controller in the Valve, The Pilot Pressured Oil is then allowed to flow to either end of the Spool thus causing it to shift. The amount of Pilot Pressured Oil to either end of Spool is varied with the Pilot Oil Control Valve by the Electric Controller there by controlling the distance the Spool Shifts. This in turn controls the volume of Oil sent to the Cylinders and consequently, the Speed of activation of the Cylinders.

The Tilt and Door Function, While not proportionally controlled are controlled by Pilot Oil Control Valves. However instead of opening or closing based on Joystick Position, These Valve will fully open or fully closed when activated, Tilt and Door Functional are not proportional they are open full or closed full only.

When the Function is returned to Neutral at the Joystick, The Electrical current to the Valve Controller is stopped. There fore the Pilot Oil Control Valves return to their normal positions and the Flow of Pilot Pressure Oil to the Main Spool is stopped. The Springs on the Main Spool returns the Spool to its centered (Neutral) Position. When the Spool is centered the Load Sense Signal stops. With no Load Sense Signal present the Pressure Bypass Adjustment Spool allows most of the Oil in the Pressure ("P") Port to return to the Tank ("T"). The Pilot Reducing Valve retains Pilot (Standby) Pressure in the Valve.

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CONTROL VALVE - FIXED DISPLACEMENT

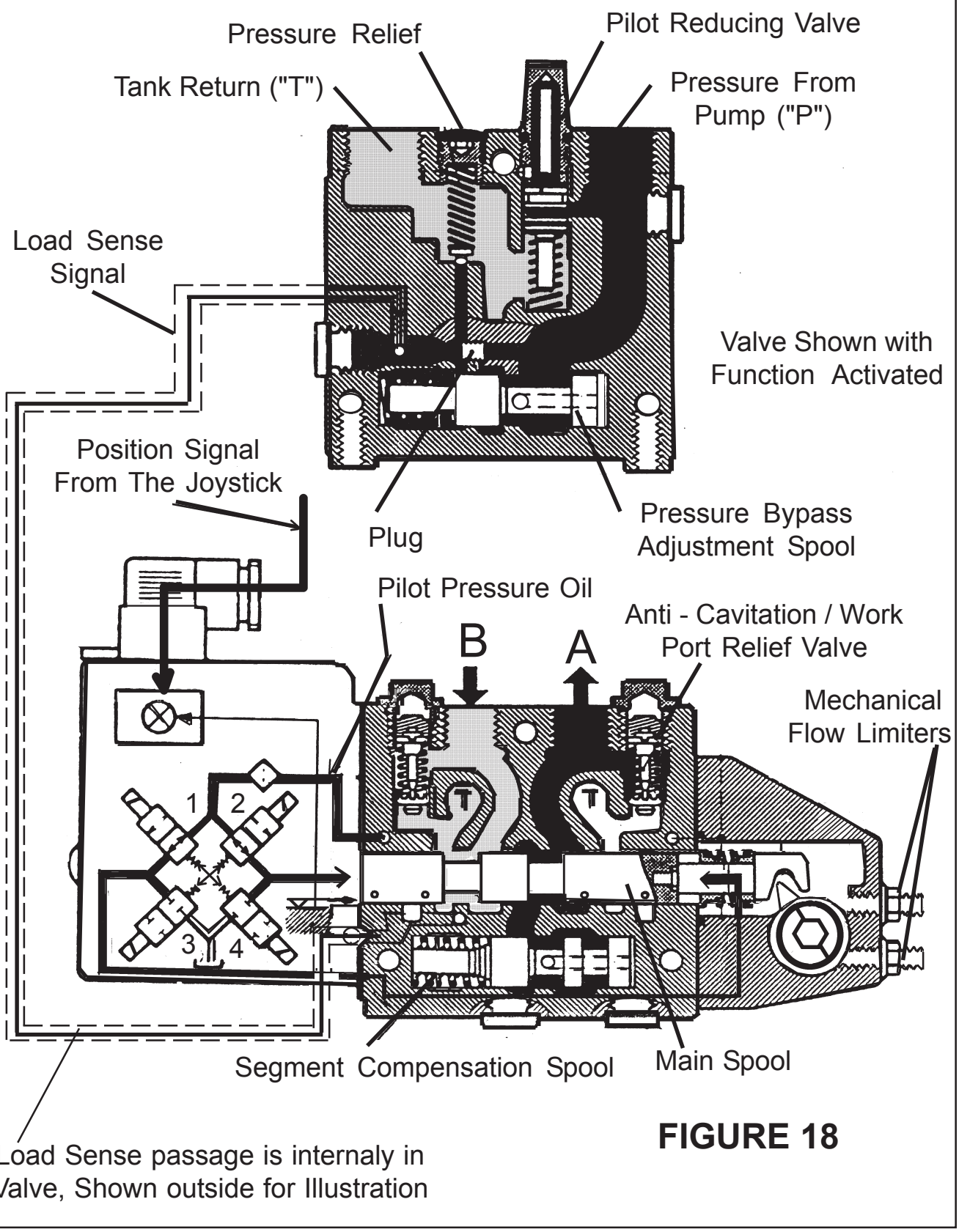

FIGURE 18

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NOTES

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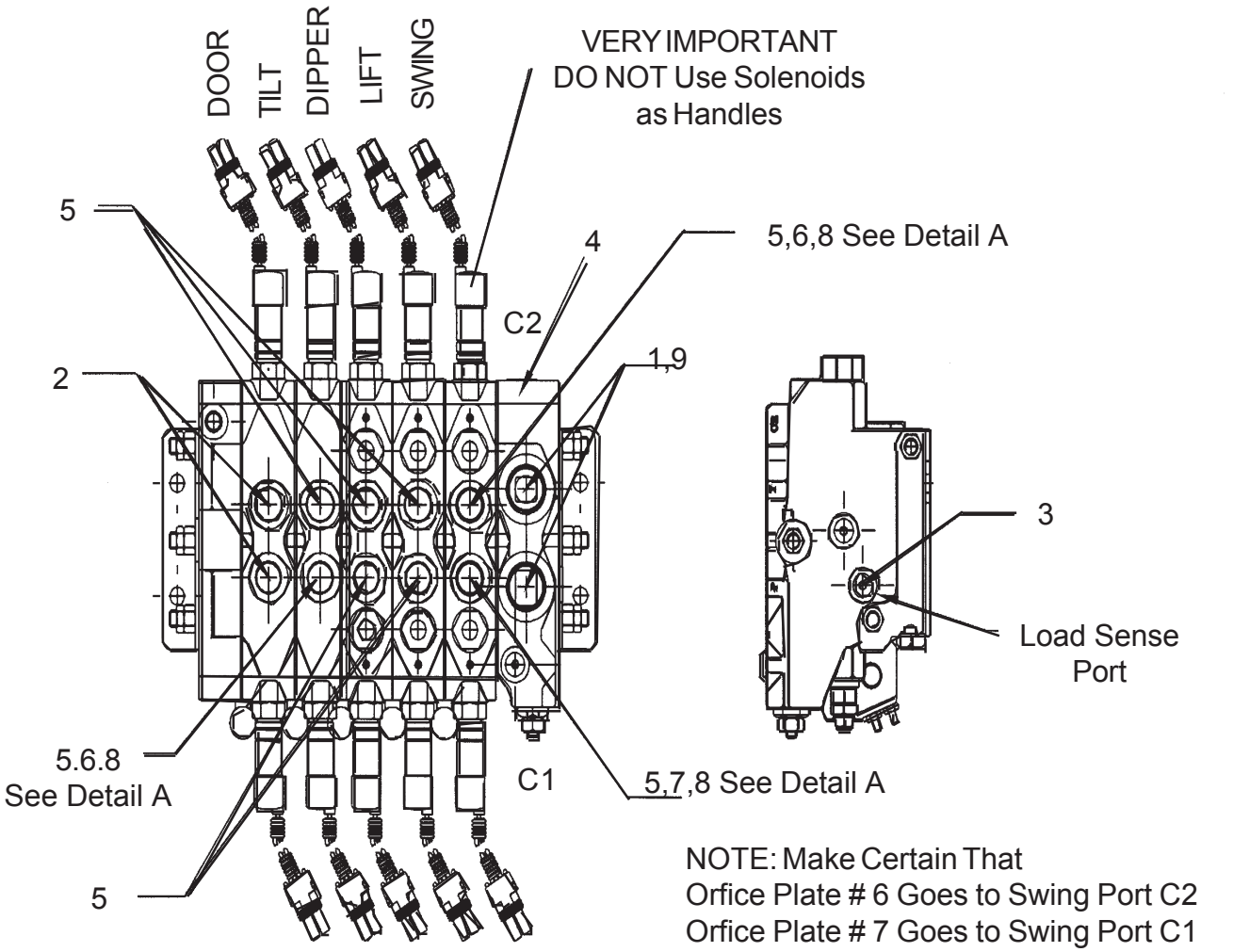
May 1995
to
Dec.1997

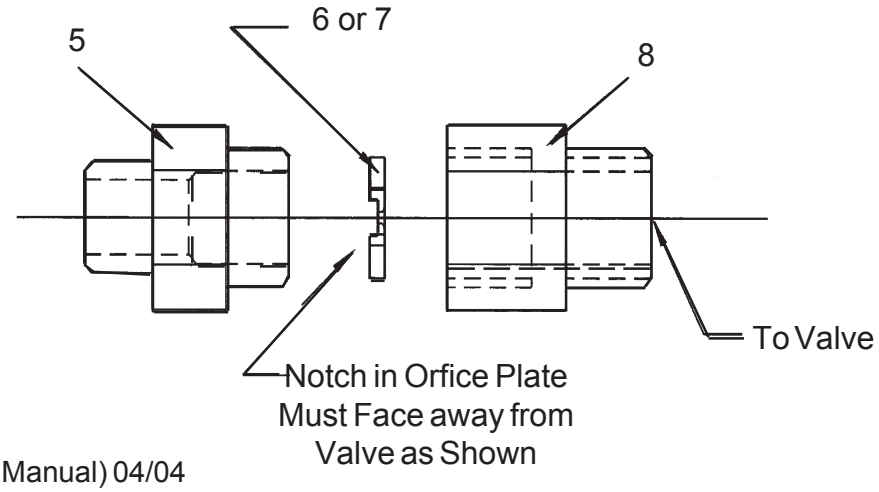
VALVE ASSEMBLY
Load Sense
P/N 02968851

S/N MB21-01001
S/N MB24--01001
to
S/N MB21-01109
S/N MB24--01046



NOTE: Make Certain That
Orfice Plate # 6 Goes to Swing Port C2
Orfice Plate # 7 Goes to Swing Port C1
Orfice Plate # 6 Goes to Tilt Plate Port C1

DETAIL A



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May 1995
to
Dec 1997

VALVE ASSEMBLY
Load Sense
P/N 02968851

S/N MB21-01001
S/N MB24--01001
to
S/N MB21-01109
S/N MB24--01046

Item	Part No.	Qty	Description
	02968851	**--**	**Valve Asy. 5 Spool (Load Sense)**
1	02761100	2	Adapter, Elbow, 90 Deg.
2	02822300	2	Adapter, Straight
3	02960018	ref	Adaptor ,Elbow, 90 Deg.
4	02967201	1	Valve, Load sense, 5 Spool
5	02968850	8	Adapter, Straight
6	02969398	2	Orfice, for C2 Port, .055 Dia. Hole
7	02969399	1	Orfice, for C1 Port, .040 Dia. Hole
8	02969400	3	Adapter, Straight
9	63042700	2	Adapter, Straight

NOTE: To help ID Valve, The Wiring Harness on this valve has 10 Plugs, 5 on each side of the valve, The later version will only have 5 plugs and they are only on one side of the valve

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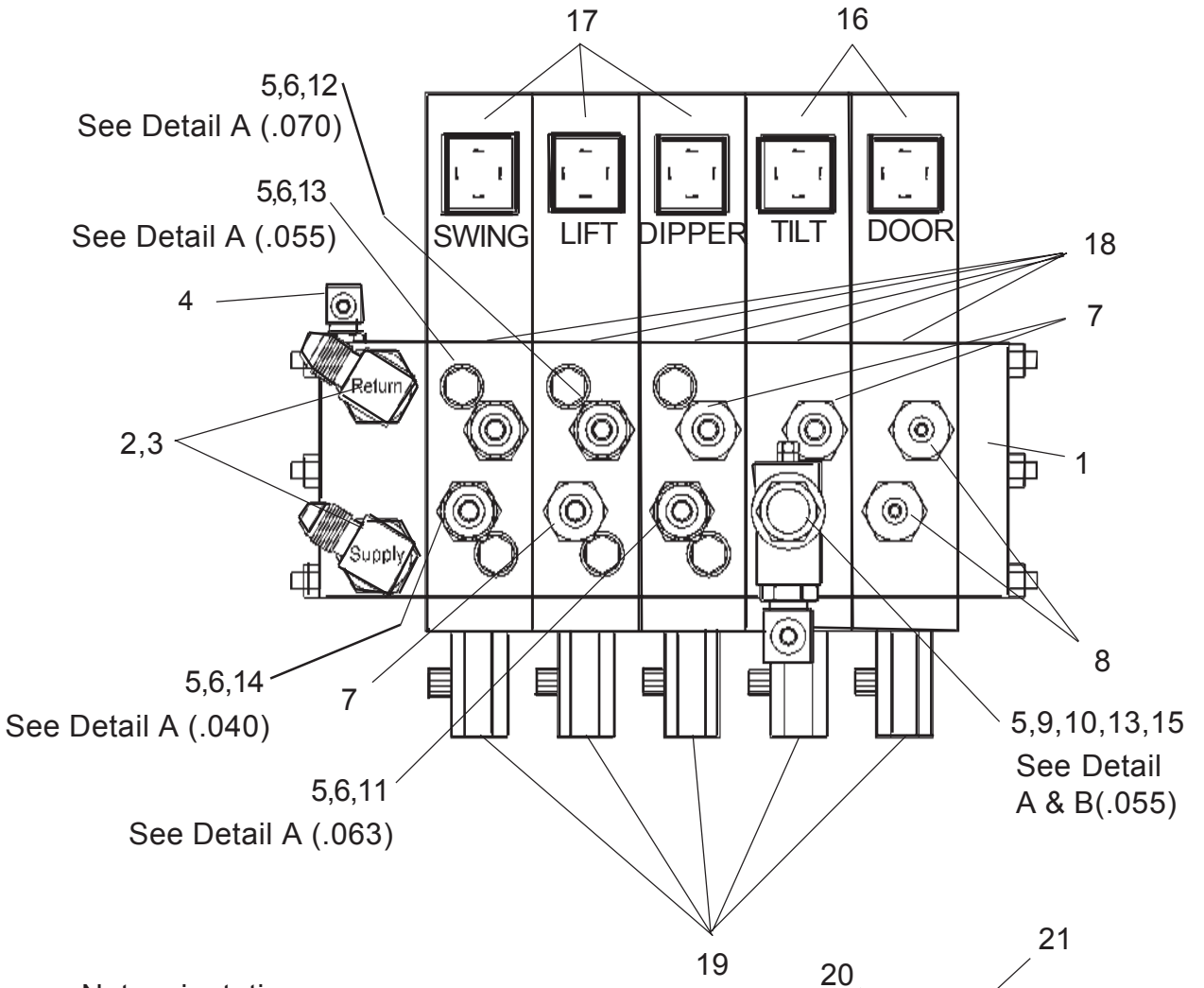
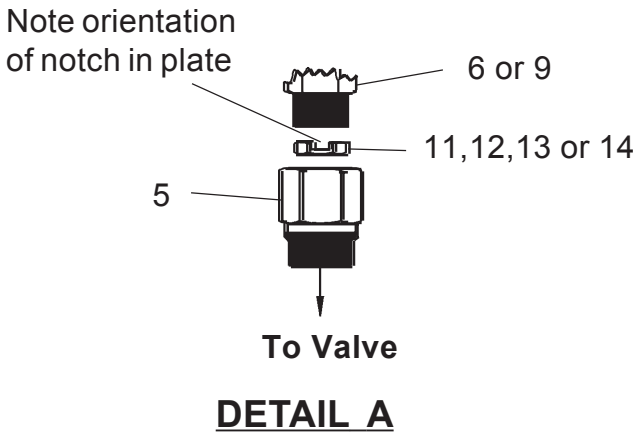
Jan. 1998
to
Sep. 2000

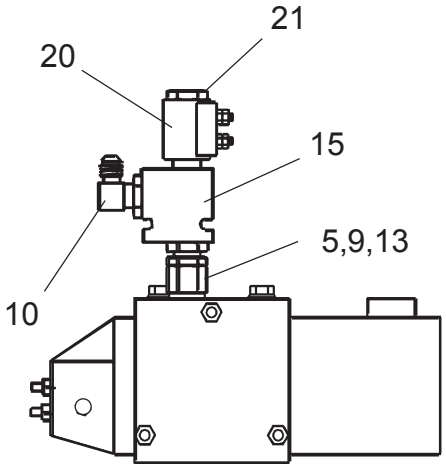
VALVE ASSEMBLY
Load Sense
P/N 02972175

S/N MB21-01110
S/N MB24--01047
to
S/N MB21-01571
S/N MB24--01246





DETAIL A



DETAIL B

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Jan 1998
to
Sep. 2000

VALVE ASSEMBLY
Load Sense
P/N 02972175

S/N MB21-01110
S/N MB24--01047
to
S/N MB21-01571
S/N MB24--01246

Item	Part No.	Qty	Description
	02972175		**Valve Asy. 5 Spool**
1	02971378	1	Valve, 5 Spool CCLS
2	63042700	2	Adaptor, Straight
3	02761100	2	Adaptor, Elbow 90°
4	02972178	1	Adapter, Elbow 90°
5	02972113	5	Adaptor, Straight
6	02968850	4	Adapter, Straight
7	02972177	3	Adapter, Straight
8	02972179	2	Adaptor, Straight
9	02972180	1	Adaptor, Straight
10	001654	1	Adaptor, Elbow 90 Deg
11	02972209	1	Orifice, .063
12	02972210	1	Orifice, .070
13	02969398	2	Orifice, .055
14	02969399	1	Orifice, .040
15	02972208	1	Solenoid Lock Valve Asy
16	02974004	2	Electric Activation Module
17	02974005	3	Electric Activation Module
18	02974027	5	Seal Kit, O-Ring
19	02974838	5	Mech. Activation Module
20	02975598	1	Coil
21	02975599	1	Cartridge

NOTE: To help ID Valve, The Wiring Harness on this valve has only 5 Plugs, 5 only on 1 side of the valve, The Earlier version will have 10 plugs, and they are 5 on each side of the valve.

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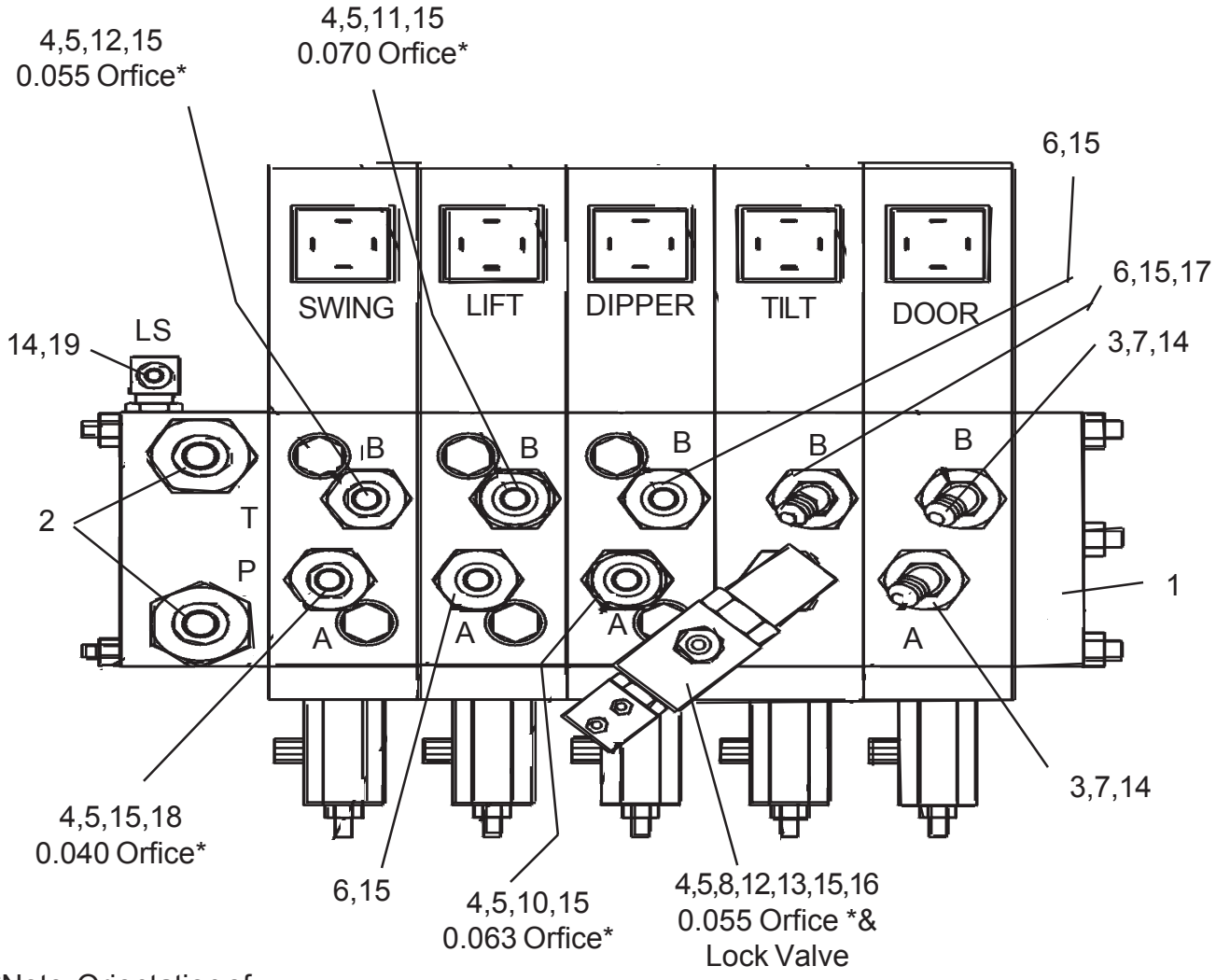
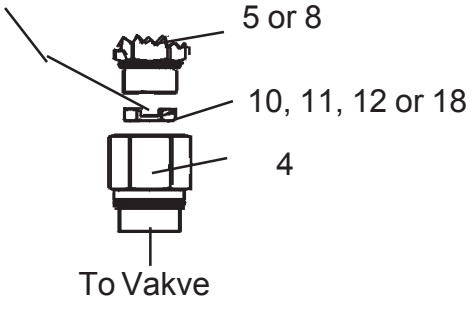
Oct. 2000
to
Current

VALVE ASSEMBLY
Load Sense
P/N 02976688

S/N MB21-01572
S/N MB24--01247
to
S/N MB21-Current
S/N MB24--Current

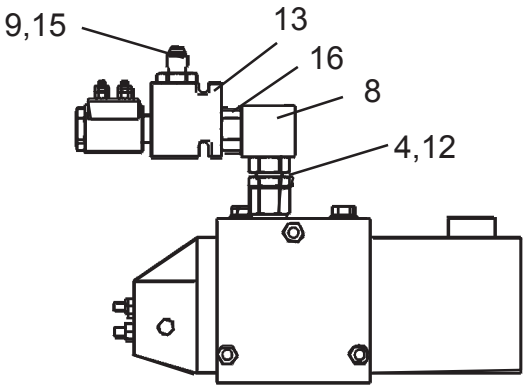


*Note: Orientation of Notch in Plate must be notch up as shown



Orfice Plate

DETAIL A



Solinoid Lock Valve

DETAIL B

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Oct. 2000
to
Current

VALVE ASSEMBLY
Load Sense
P/N 02976688

S/N MB21-01572
S/N MB24--01247
to
S/N MB21-Current
S/N MB24--Current

Item	Part No.	Qty	Description
	02976688	**-**	**Assembly Valve, 5 Spool**
1	02971378	1	5 Spool Valve CCLS
2	63042700	1	Adaptor, Straight
3	02976532	1	Adaptor, Elbow 90°
4	02972113	5	Adapter, Straight
5	02968850	4	Adapter, Straight
6	02972177	3	Adapter, Straight
7	02972179	2	Adaptor, Straight
8	02962213	1	Adaptor, Elbow 90°
9	02968850	1	Adp, Hyd. Straight
10	02972209	1	Orifice, .063
11	02972210	1	Orifice, .070
12	02969398	2	Orifice, .055
13	02972208	1	Solenoid Lock Valve Assy
14	02957416	3	Cap, Plastic Female
15	02963637	8	Cap, Plastic Outer
16	02975438	1	Adp Hyd Stght
17	02976531	1	Adp Hyd Elbow
18	02969399	1	Orifice, .040
19	02972178	1	Adp Hyd Elbow

NOTE: To help ID Valve, Note the difference in detail B from earlier Valve, The location of components in detail B. Lock Valve

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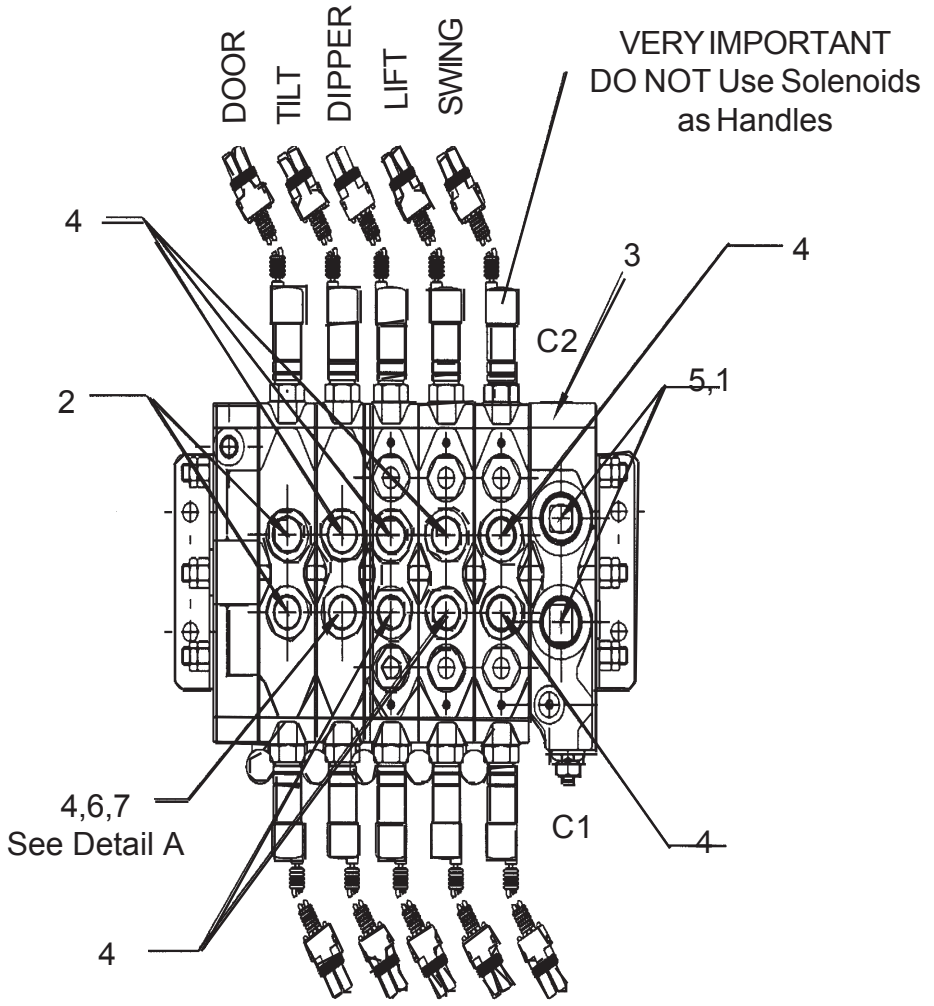
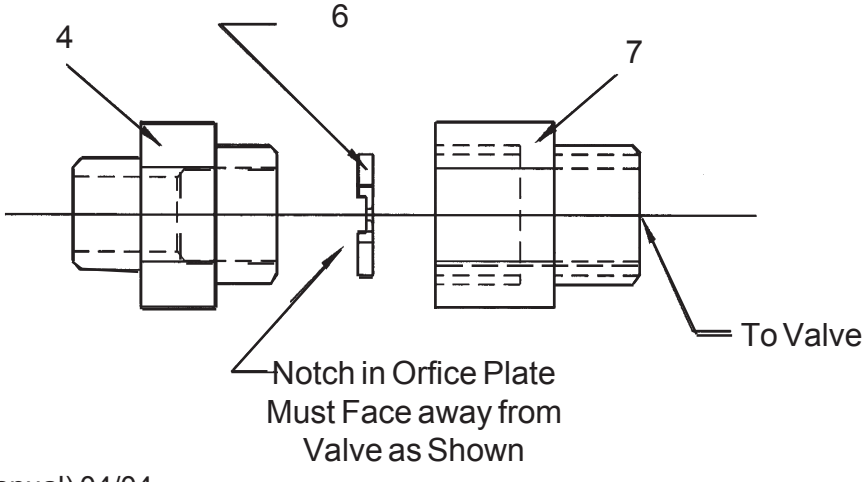
May 1995
to
Dec 1997

VALVE ASSEMBLY
Fixed Displ.
P/N 02968854

S/N MB21-01001
S/N MB24--01001
to
S/N MB21-01109
S/N MB24--01046



DETAIL A



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May 1995
to
Dec. 1997

VALVE ASSEMBLY
Fixed Displ.
P/N 02968854

S/N MB21-01001
S/N MB24--01001
to
S/N MB21-01109
S/N MB24--01046

Item	Part No.	Qty	Description
	02968854	**--**	**Valve Asy. 5 Spool, OCFD**
1	02761100	2	Adapter, Elbow, 90 Deg.
2	02822300	2	Adapter, Straight
3	02968533	1	Valve,Fixed Displ., 5 Spool
4	02968850	8	Adapter, Straight
5	63042700	2	Adapter, Straight
6	02969398	2	Orfice, .055 Dia. Hole
7	02969400	1	Adapter, Straight

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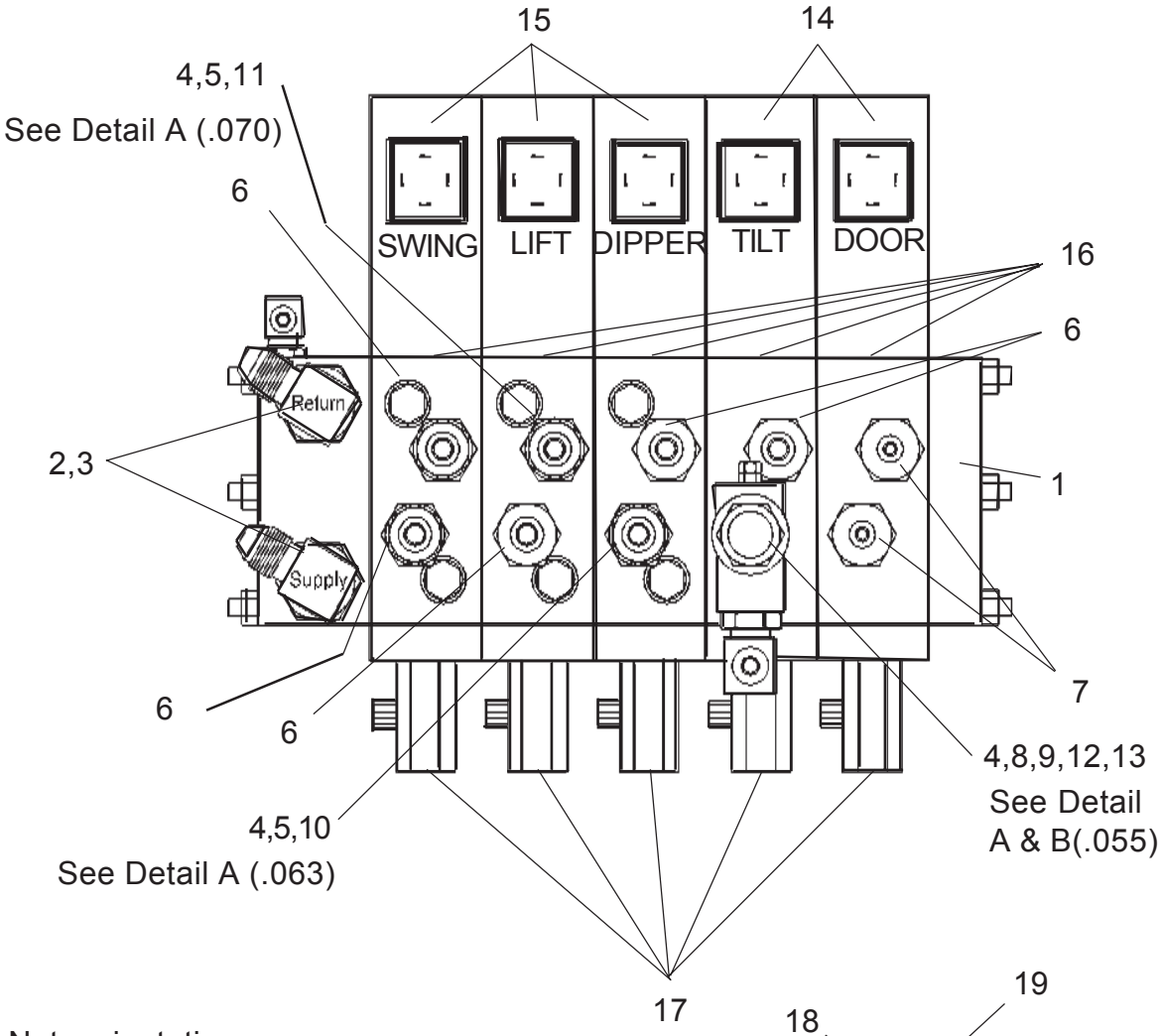
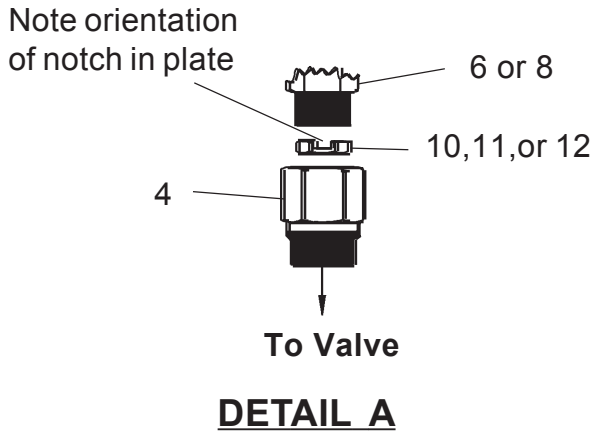
Jan. 1998
to
Sep. 2000

VALVE ASSEMBLY
Fixed Displ.
P/N 02972176

S/N MB21-01110
S/N MB24--01047
to
S/N MB21-01571
S/N MB24--01246





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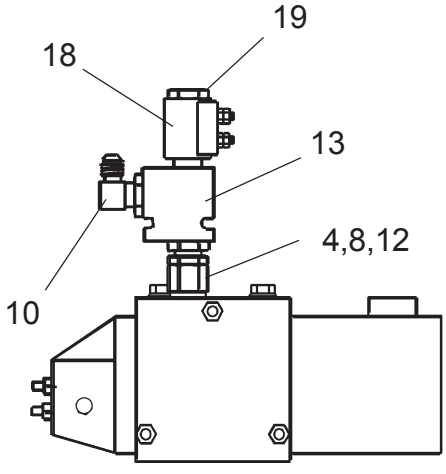

DETAIL B

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Jan. 1998
to
Sep. 2000

VALVE ASSEMBLY
Fixed Displ.
P/N 02972176

S/N MB21-01110
S/N MB24--01047
to
S/N MB21-01571
S/N MB24--01246

Item	Part No.	Qty	Description
	02972176		**Valve Asy. 5 Spool**
1	02971379	1	Valve, 5 Spool OCFD
2	63042700	2	Adaptor, Straight
3	02761100	2	Adaptor, Elbow 90°
4	02972113	3	Adapter, Straight
5	02968850	2	Adaptor, Straight
6	02972177	5	Adapter, Straight
7	02972179	2	Adaptor, Straight
8	02972180	1	Adaptor, Straight
9	001654	1	Adaptor, Elbow 90 Deg
10	02972209	1	Orifice, .063
11	02972210	1	Orifice, .070
12	02969398	2	Orifice, .055
13	02972208	1	Solenoid Lock Valve Asy
14	02974004	2	Electric Activation Module
15	02974005	3	Electric Activation Module
16	02974027	5	Seal Kit, O-Ring
17	02974838	5	Mech. Activation Module
18	02975598	1	Coil
19	02975599	1	Cartridge

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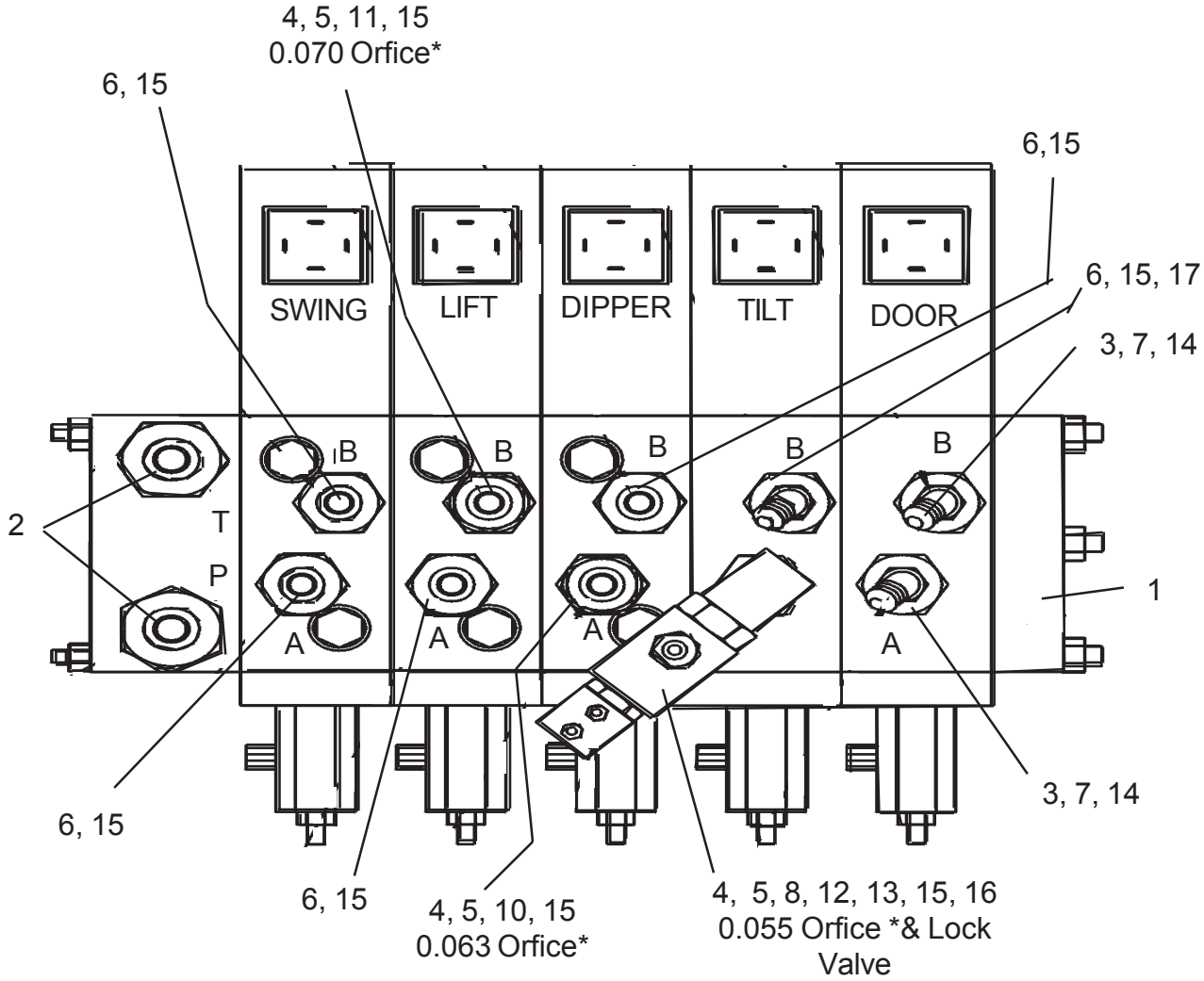
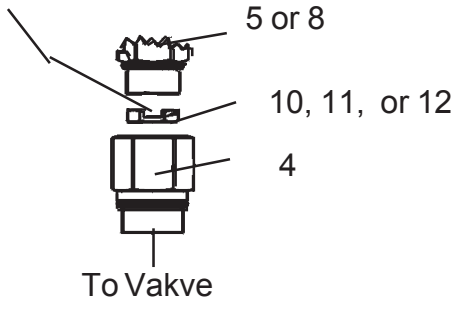
Oct. 2000
to
Current

VALVE ASSEMBLY
Fixed Displ.
P/N 02976533

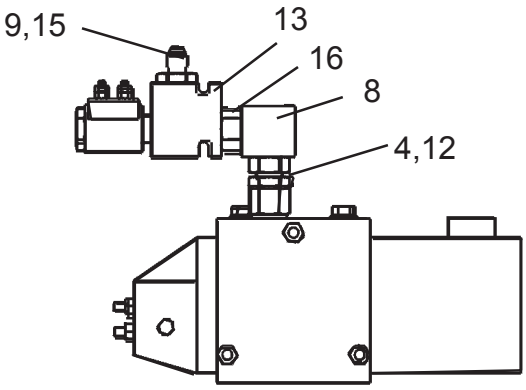
S/N MB21-01572
S/N MB24--01247
to
S/N MB21-Current
S/N MB24--Current



*Note: Orientation of Notch in Plate must be notch up as shown



Orfice Plate



Solenoid Lock Valve

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Oct. 2000
to
Current

VALVE ASSEMBLY
Fixed Displ.
P/N 02976533

S/N MB21-01572
S/N MB24--01247
to
S/N MB21-Current
S/N MB24--Current

Item	Part No.	Qty	Description
	02976533	**-**	**Assembly Valve, 5 Spool**
1	02971379	1	5 Spool Valve OCFD
2	63042700	1	Adaptor, Straight
3	02976532	1	Adaptor, Elbow 90°
4	02972113	1	Adapter, Straight
5	02968850	4	Adapter, Straight
6	02972177	3	Adapter, Straight
7	02972179	2	Adaptor, Straight
8	02962213	1	Adaptor, Elbow 90°
9	02968850	1	Adp, Hyd. Straight
10	02972209	1	Orifice, .063
11	02972210	1	Orifice, .070
12	02969398	2	Orifice, .055
13	02972208	1	Solenoid Lock Valve Assy
14	02957416	2	Cap, Plastic Female
15	02963637	8	Cap, Plastic Outer
16	02975438	1	Adp Hyd Stght
17	02976531	1	Adp Hyd Elbow

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Control Valve Trouble Shooting Section

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MACHETE CONTROL VALVE

HYDRAULIC SYSTEM - POSITIONING - TEST PROCEDURES

NOTE: The Machete is equipped with manual override controls for the Control Valve. In case of Emergency Electrical failure or for testing purposes, The positioning Hydraulics can be operated manually. Refer to Isolation Test 2 for instructions or review Control Valve Section.

IMPORTANT NOTE:

1. Repairing a failed Component is not always repairing the Cause of a failure, When making repairs always check all associated components because one component can be the cause of another component failure.

INFORMATION COLLECTION: Any information on Unit from operator will be helpful.

1. What is Model Unit, Size, Type Head, Type Tractor it is mounted on etc?
2. What is not working correctly? In as much detail as possible.
3. Has this malfunction existed for some time, just start suddenly, continuos malfunction or off and on, when does malfunctions occur.
4. Did this malfunction result from an earlier malfunction? What if any repairs, adjustment, modifications or any changes to any components have been made to unit recently. (Repairs - Maintenance - Accidents - Operator Change)
5. Have all the obvious items been checked, Oil Levels (Tractor & Unit Reservoirs), Electrical Supply (Dead Battery, Loose connections, etc.)
6. Does the malfunction affect all circuits, one, two or more?
7. Does malfunction affect both sides of the same function or just one (Example Lift & Lower, in or out, etc)
8. Does malfunction happen when Cold or Hot, only Cold or only Hot, more when Cold than Hot, more when Hot than Cold etc.
9. What Conditions? What is Unit doing when malfunction occurs, running at low? RPM, High RPM, heavy Cutting, light Cutting, Level Ground, Slope Angle etc.
10. Any information that will help determine what may be causing the Malfunction or to pin point the location of the malfunction.

VISUAL TEST:

1. Do Not Start Tractor till all visual inspections are done. Check All Fluid Levels (Fluid Levels should be checked with oil warm and with all components filled with Oil from operation), Remove any bolt on / Slip on Cover that prevent visual inspection of general condition of components. Look for any Broken Components, Missing Components, Loose Components, Oil Leaks, Damaged Components. Look for any thing that is obvious to cause a problem.
2. Replace any missing / broken components, tighten any loose components, repair any Oil Leaks before beginning any further test.

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OPERATIONAL TEST:

1. Visual Test should have been done already, If not go back one page and perform visual test now. Pump and/or Valve covers should be removed.
2. Start Tractor Engine, When starting Machete Boom functions always listen to sound of Engine, Sound should change when Boom Hydraulics are in the working position.
3. With Tractor Engine running operate each Circuit, Paying close attention to every thing the unit does or does not do.
4. The Engine speed should drop (the Sound Change) when the Valve spool moves and the Pump comes under a load, If the Engine sound does not change when the Circuit is activated (on a Load Sense System) it is an indication that there is a possible malfunction in the Load Sense Circuit.
5. Observe each function of the Joystick control throughout its complete range of movement. Check the Cylinder speeds, Look for “Jerky” operation (the Cylinder should respond smoothly to the movement of the Joystick). Look for time delay between movement of Joystick and movement of Cylinders.
6. After checking each function, attempt to duplicate the malfunction described by Operator, Using the information gathered in the Operator Interview. If you are not able to get machine to malfunction, see if operator can get the machine to malfunction.
7. When the Malfunction occurs, take note of all conditions that exist during the time of the malfunction, Some things to take note of are,
    - **A.** Engine Speed or Sound.
    - **B.** Position of Articulating Members.
    - **C.** Operating Temperature
    - **D.** Length of time Unit has been running
    - **E.** Position of Joystick before and during malfunction.
    - **F.** Position and Condition of Tractor
    - **G.** Any other condition you might notice.
8. Duplicate the conditions that existed when the malfunction occurred to determine if the malfunction will occur every time that the same conditions exist. Try different combinations of conditions to determine which conditions actually affect the malfunction and which ones just happened to be there when the malfunction occurred.

ISOLATION TEST 1:

1. This test must be performed while the malfunction is occurring. This Test is used when one or more functions are inoperative (either constant or intermittent) This procedure applies to units utilizing a general application, Read directions as to which series of Valve, there are early model versions and late model versions. The following is for the late model version.

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ISOLATION TEST 1: (Continued from previous page)

2. Re-check to make sure all fluid levels are OK. The Control Valve Cover should still be removed. Make sure that the Tractor Transmission is in Neutral and the Park Brake is set and Holding, Test Park Brake before continuing. Make sure that Boom and Cutting Head are resting on the ground.

3. With the help of an assistant, One Person stand outside the Tractor in a position to observe the Manual override control, which is 9 mm Hex head (on Later Version, 1/2" on early models) located on each Valve Section, (See Figure 19) The other person will operate the Joystick from the Operators Seat. If Manual override is not moving check the electrical connections.

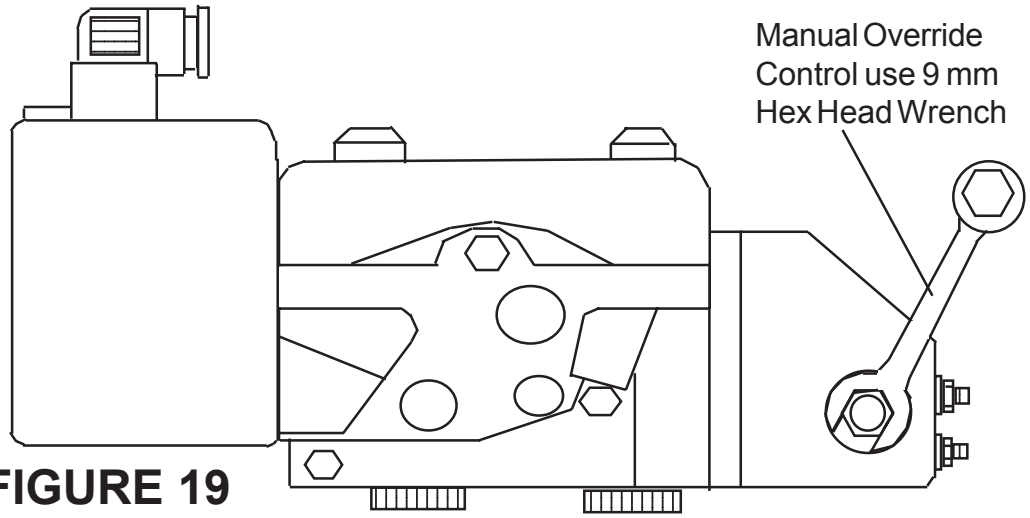

FIGURE 19

4. While the malfunction is occurring, one person should actuate the Joystick while the other observes the manual override control for that specific function (See Figure 19). The Manual Override control should move in relation to the movement of the Joystick movement. Each Valve Section will have one of these Hex Head Overrides.

5. If the Manual Override control moves properly when the Joystick is moved:

- **A.** The Joystick is working.
- **B.** Wiring Harness is OK.
- **C.** Solenoid valve(s) are working.
- **D.** Pilot Pressure Oil is Present.
- **E.** Valve Spools are moving.
- **F.** Cause is most likely in Valves, Hoses or Cylinders.

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ISOLATION TEST 2:

1. This Procedure applies to Units utilizing the Late Model Control Valve Assemblies used 1998 and up.
2. Re-check to make sure all fluid levels are OK. The Control Valve Cover should still be removed. Make sure that the Tractor Transmission is in Neutral and the Park Brake is set and Holding, Test Park Brake before continuing. Make sure that Boom and Cutting Head are resting on the ground.
3. Locate the manual override control on Control Valve (See Figure 20) for the Valve circuit that is malfunctioning (or you want to test). Each Section of the Valve has manual override control.

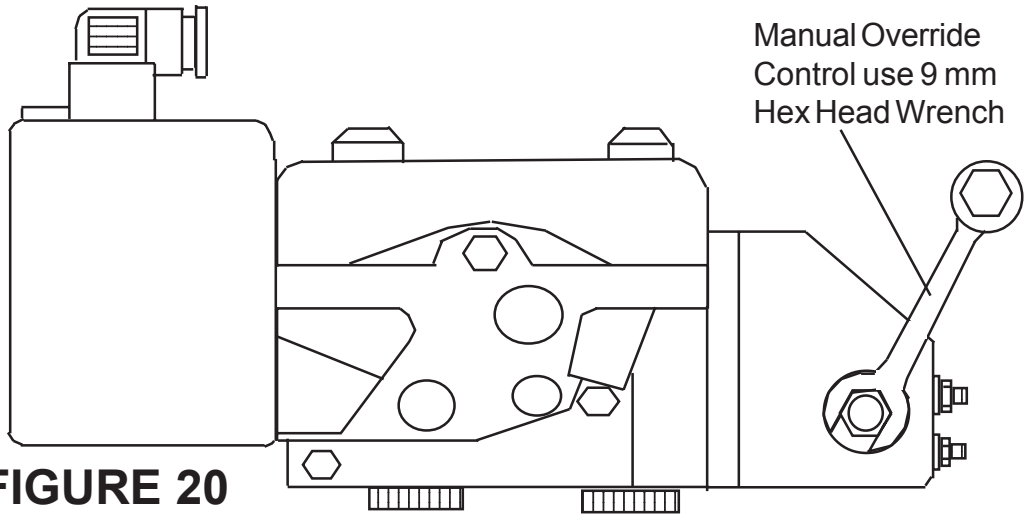

FIGURE 20

4. Start the Engine and let the Engine run at least 1000 RPM
5. Using a 9 mm Open Wrench (See Figure 20) actuate the manual override controls for the Circuit that is malfunctioning. Take note of the reaction of the Circuit to all positions of the control. Also take note of the Smoothness of Spool Operation. The Spool should move smoothly. If it doesn't it can indicate contamination in the system or something wrong with Spool causing it to bind.
6. If the Circuit fails to work with the Joystick and works properly with the manual override control, The problem is in the Electrical Control Circuit, The Solenoid Valve, Joystick or Wiring Harness or Pilot Pressure.
7. If the circuit fails to work using the Manual Override Control, The Problem is in the Control Valve, Hoses or Cylinder.
8. Use this test to determine which components to test and/or trouble shoot.

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SOLENOID VALVE TEST: (See Figure 21)

1. Using this test to determine if the Malfunction is in the Solenoid Valve Assembly after having performed Isolation Test 1 and 2. This test is used when some circuits are operating and one or more are not, The Circuit will work manually as described in Isolation Test 2 but not electrically.
2. Start with the Engine "OFF" and the Control Valve Cover still removed.
3. Connect the Solenoid Valves of the inoperative Valve Section to the Harness connections of a Valve section that is known to be operational (See Valve Diagram), remember some are proportional and some are not. Connect (for Testing) Swing, Lift and Dipper Functions (Proportional) or connect Door to Tilt (Non-Proportional) for testing. In other words connect (Swap) the Harness connection from Questionable Circuit with a good Circuit.
4. Operate the Joy stick function for Both swap Circuits, (NOTE: You swapped connections so the movement of Joystick one way will have a different Cylinder movement now). KEEP this different movement in Mind.
5. If the inoperative circuit begins to work now and the former function is inoperative, The problem most likely is in the Joystick Wiring Harness.
6. If the Inoperative Circuit STILL FAILS to operate, and the Known operative circuit continues to function properly, The problem is most likely in the Solenoid Valve (Providing that the Circuit functioned when Manually operated with Manual Override).

NOTE: See Directions above, Disconnect connector for malfunctioning circuit and recoonect to a known operational circuit for testing.

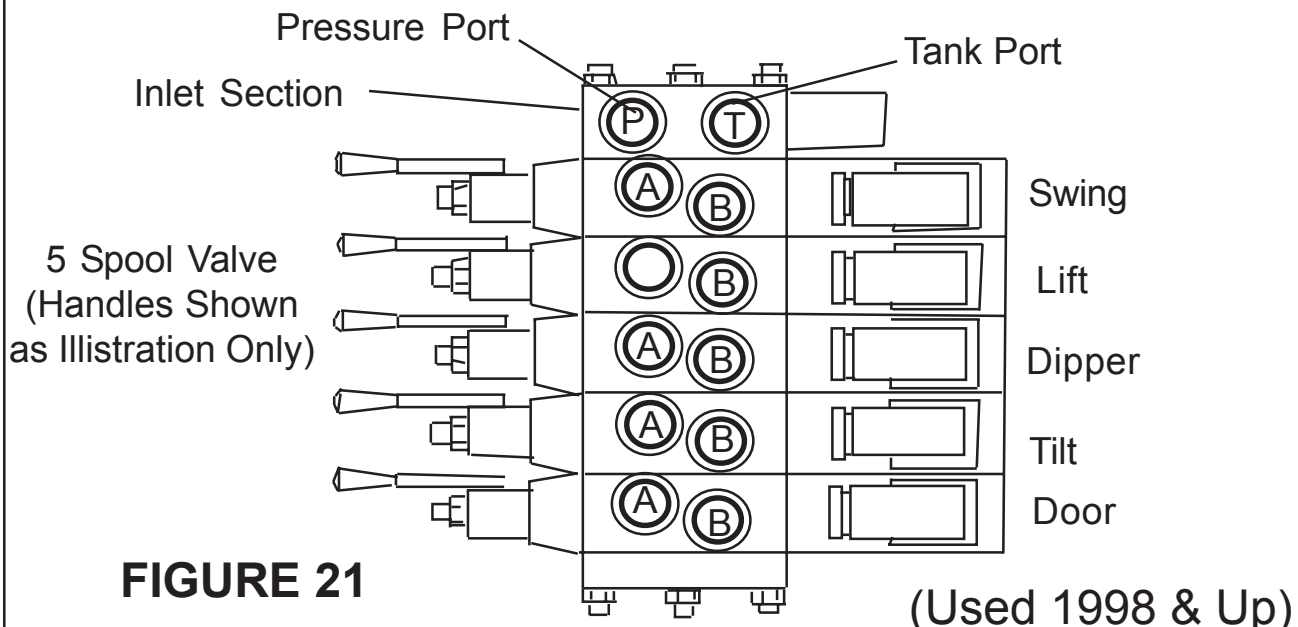

FIGURE 21

(Used 1998 & Up)

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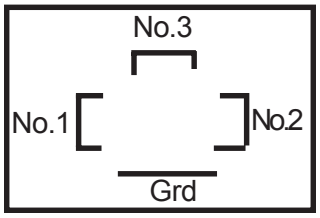
TROUBLE SHOOTING - TESTING

The Slots are numbered:

No. 1	Positive, 12 Volts DC
No. 2	Positive, Should be 1/2 Voltage of Slot No. 1 to Ground (6 Volts if 12 Volts etc.) because current is being reduced
No. 3	This Slot is not used at all Grd. Negative, Common Ground, A long Slot, (Not Marked).



Harness Plug

THE ABOVE INFORMATION IS FOR TESTING THE NEW STYLE VALVE ONLY

USE A VOLT METER TO TEST. THE NEW STYLE CAN BE ID BY THE 5 PLUGSON ONE SIDE WHERE HARNESS CONNECTS TO VALVE, THE OLD STYLE HAD 10 PLUGS, 5 ON EACH SIDE>

MAKE SURE IF OLD STYLE OR NEW STYLE VALVE IS USED BEFORE TESTING THIS IS IMPORTANT

THE INFORMATION ON THE NEXT PAGE IS FOR TESTING OLD STYLE VALVE ONLY

To ID Old Style Valve it will have 10 Plugs on Wiring Harness where it plugs on to Valve, The Newer Style Only has 5, For testing new Style see Previous Pages. DO NOT USE THESE to Test Newr Style Valves with5 Plug Harness.

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JOYSTICK - WIRING HARNESS TEST: (See Figure 22 & 23) Old Style Valve testing

1. Perform this Test when Isolation Test 1, Isolation Test 2 and Solenoid Valve Test have been Completed and indicates that the cause of an inoperative or intermittent complaint is located in the Joystick or Harness.
2. A Handy TIP to make a tester is shown in Figure 19, To make this tool use a discarded Plug (or purchase one Locally) and wire a 12 volt bulb into it, If doing a lot of testing might want to consider making one for each connection. By making this type tester you will be able to test the positive (+) and negative (-) connection at the same time and this would allow the test to be performed by one person and decrease the chance of making a connection wrong. A normal 12 volt test Light can be used as shown in Figure 23, but this method normally requires two people to perform and Test Light Must be connected correctly.

FIGURE 22

3. Disconnect the Wiring Harness Connector at Valve for the inoperative Circuit at the Valve Solenoid Connection.
4. Connect the Test Tool you built (or 12 Test light) to the Harness end of the connector, (If using a test light to check a positive (+) connection be sure to ground Test Light to a good ground connection, if testing a Negative (-) connection it would be required to reverse the + to - Connection. (See Figure 22)
5. While actuating the Joystick, Test for voltage at the connect (if using Tool you Built the Bulb should light up or test light should light up). If test light comes on then this circuit is OK, If using a normal Test Light see Figure 23 both sides of connection will need to be tested; this may require an assistant

(Connection for Testing Positive (+) Side Shown Below)

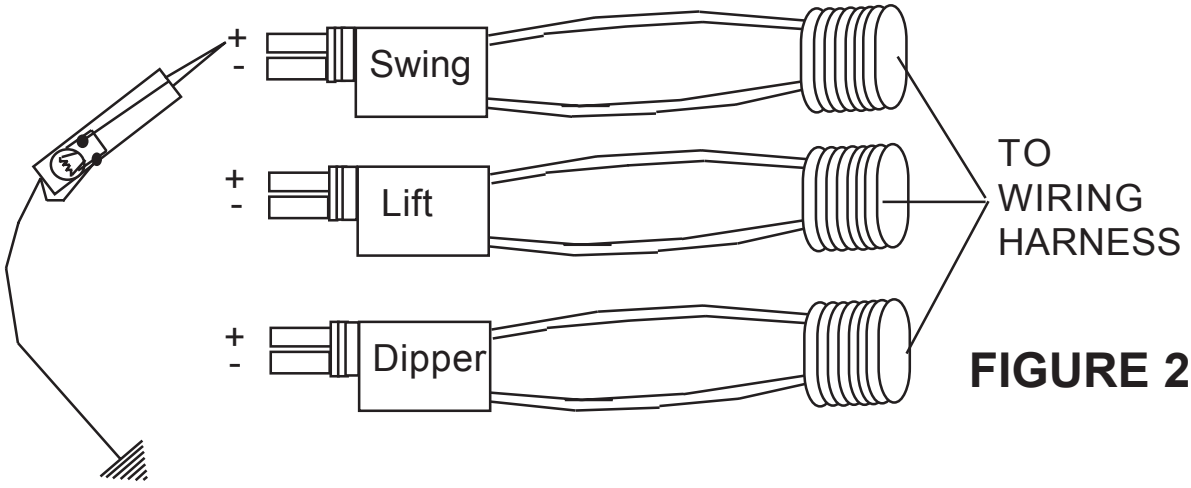

FIGURE 23

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PUMP SECTION

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PUMP - GENERAL

INTRODUCTION:

The information in this Section of Book is re-printed with Permission of the Eaton Corp. This Section of Book provides service information for the Servo Controlled Piston Pump P/N 02967192. Step by Step instructions for the complete dis-assembly and re-assembly of the Pump are given. In Most diagrams there are no Component Part Numbers Listed, Only Item numbers and Descriptions, This is because most parts shown as break-down in drawings are for location & identification only and are not available as replacement parts. NO Dirt at all should be around Parts during repairs.

BEFORE STARTING REPAIRS: Service Rules (READ THIS)

1. Remove Front Cover. Clean Pump and surrounding area completely before removing any connections or Lines. NO DIRT OR DEBRIS CAN BE ALLOWED ON OR NEAR HYDRAULIC SYTEM IF IT IS BEING WORKED ON, ANY DIRT OR CONTAMINANTS IN SYSTEM NO MATTER HOW SMALL WILL DAMAGE SYSTEM!
2. After cleaning around all connections thoroughly, Dis-connect all connections, Lines, Hoses, Wiring and Remove the Pump Completely from the Tractor. Plug all hoses and Lines on Tractor and on Pump, DO NOT leave any open Lines. NO Contamination Should be allowed into system at all.
3. Clean Area, Clean all Tools, Pans etc. The cleaning of Area and Tools MUST be done before moving (Cleaned) Pump there. Drain Oil from Pump, Recheck outside of Pump to Make Sure it is Clean
4. After dis-assembly of Pump wash all metal components in clean solvent.
5. Use compressed Air to dry parts after washing (Compressed air must be filtered and moisture free). DO NOT wipe them dry with Paper Towels or Cloth as these will leave lint and/or dust contamination. DO NOT USE Compressed Air to spin any component (Such as Bearings or Plates) as this will damage them and could be dangerous.
6. Always use new Seals when re-assembling Hydraulic Pumps, Lubricate the new rubber Seals with a Petroleum Jelly, (Vaseline) before installing them.
7. DO NOT reinstall worn or damaged Parts back in Pump, DO NOT Use a worn or damaged Pump Housing.
8. Torque all Bolts over Gasketed Joints. Then repeat the Torque sequence to make sure Bolts are tight, some times Gaskets can give a Torque reading that is OK but is not, so always re-check Torque.
9. Verifying the accuracy of Pump Repairs on an authorized test stand is essential.

REQUIRED TOOLS:

1. Hex Allen Wrench (Qty 5) (9/16", 5/32", 5/16", 3/32", 5/64"
2. Retaining Ring Pliers (Qty 3), 1 each of Internal (Straight .070 tip) internal (Straight .090 tip) & 1 each External (Straight 0.90 tip)
3. Retaining E-Ring Applicator (Qty 2), 1 each 9/32" & 1 each 1/2".
4. O-Ring Pick (Qty 1)
5. End Wrench (Qty 4), 1 each of 7/16", 9/16", 3/4", 1"
6. Torque Wrench (Qty 1), 0 to 100 ft. lbs. (135.6 nm) capacity
7. Hammer, Soft Face (Qty 1)
8. Seal Driver Set (Qty 1)
9. Arbor Press (Qty 1)
10. Sockets (Qty 3) 7/16", 9/16", 3/4" (Drive Size should match Torque Wrench Drive)
11. Light Petroleum Jelly (Vaseline)
12. Locktite, # 222 and #277 or equivalent (Qty 1 tube each)

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PUMP - REPAIR TOOLS

RECOMMENDED GAUGES FOR DIAGNOSTICS:

1. Inlet Vacuum: 30 PSI to 30 in Mercury (207 bar to 0 bar)
2. System Pressure Gauge: 6,000 PSI (700 bar)
3. Charge Pressure Gauge: 0 to 500 PSI (0 to 25 bar)

SYSTEM / CHARGE RELIEF PRESSURE SETTINGS:

Inlet Vacuum:	6 in Mercury (.203 bar)
Case Pressure:	25 PSI (1.7 bar)
Charge Pressure:	250 to 300 PSI (17.24 to 20.68 bar)
System Pressure:	4500 PSI Max / 3000 PSI Continuos (306 bar Max 207 bar Continuos)
Motor Relief:	4000 PSI (272 bar)

The High Pressure relief Valves are all Factory Pre-Set and Cannot be re-adjusted.

The Pressure Setting is stamped on each valve with a three digit Code number. To identify, Multiply this stamped number by 10 to get the Valves pressure settings, Example 500 stamped in valve is 10 X 500 = 5000 PSI (345 bar).

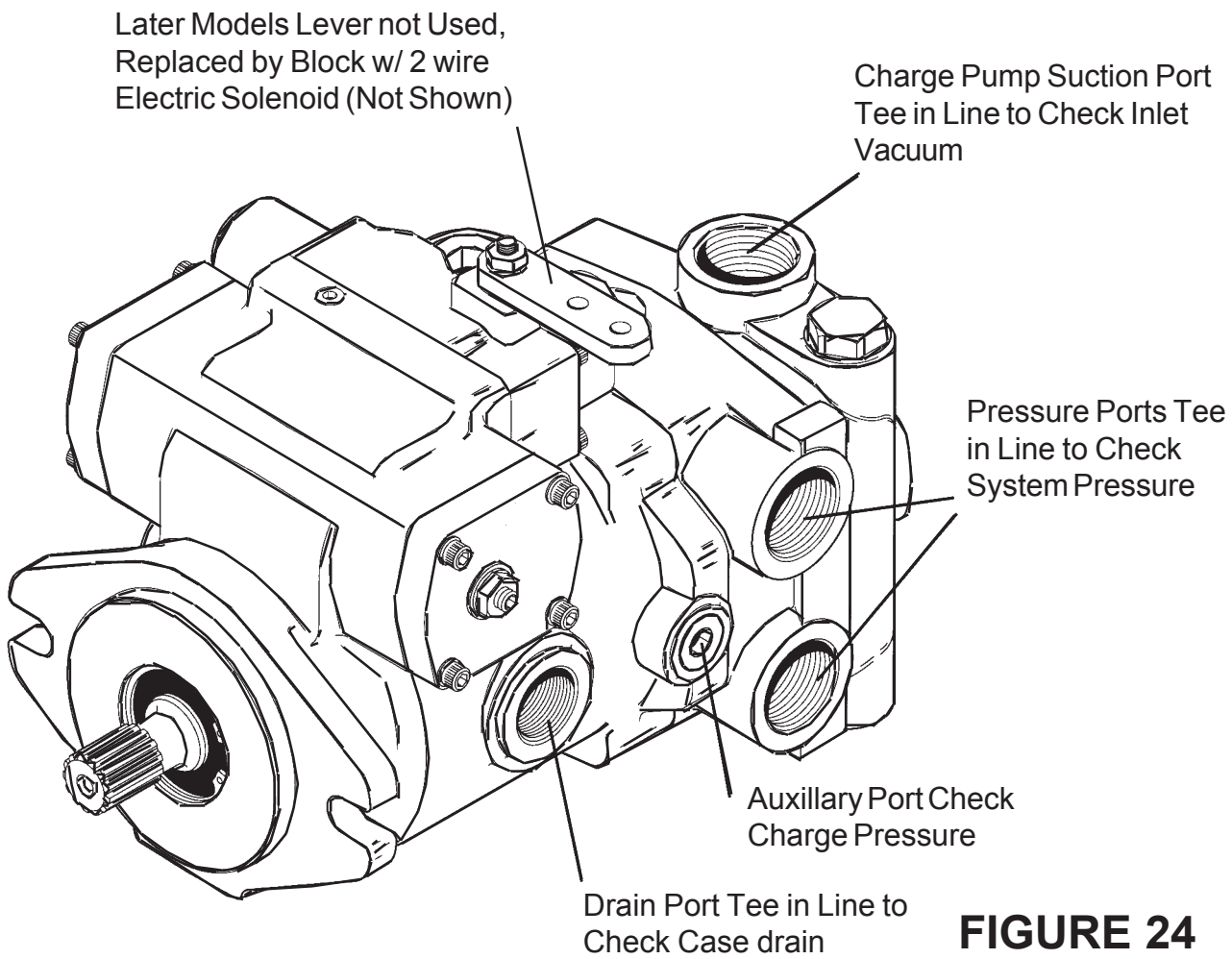
Later Models Lever not Used, Replaced by Block w/ 2 wire Electric Solenoid (Not Shown)
Charge Pump Suction Port Tee in Line to Check Inlet Vacuum
Pressure Ports Tee in Line to Check System Pressure
Auxillary Port Check Charge Pressure
Drain Port Tee in Line to Check Case drain

FIGURE 24

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PUMP CIRCUIT - MOTOR ENGAGE

Note: The Servo Control Valve, Lever and Solenoid have been replaced by a manifold and Solenoid valve Cartridge, Please make note on all diagrams and text.

The Method used on the Machete to transmit Engine Power to the Mowing Head is called a “Closed Loop” or “ Hydrostatic” System (Figure 39). Engine Power is converted to Hydraulic Power by the Variable Displacement Hydraulic Piston Pump. Oil is sent to the Fixed Displacement Motor through the Hoses that run down the Boom. Oil passing through the Motor converts the Hydraulic Power Back into Mechanical Power to Rotate the Blades.

The Shuttle Valve in the Motor returns 8 GPM back to the Tank for Cooling. The remainder of the return oil remains in the Closed Loop. Some of the advantages of using a Closed Loop System for the Motor Circuit are, 1. A Smaller quantity of Oil is required, 2. System acts as its own “Brake” slowing down the Blades and 3. Less Fuel consumed due to “No Load” condition when Motor Circuit is disengaged.

Another feature of the Alamo System is that the Oil is filtered after it leaves the Charge Pump and before it enters the High Pressure Loop.

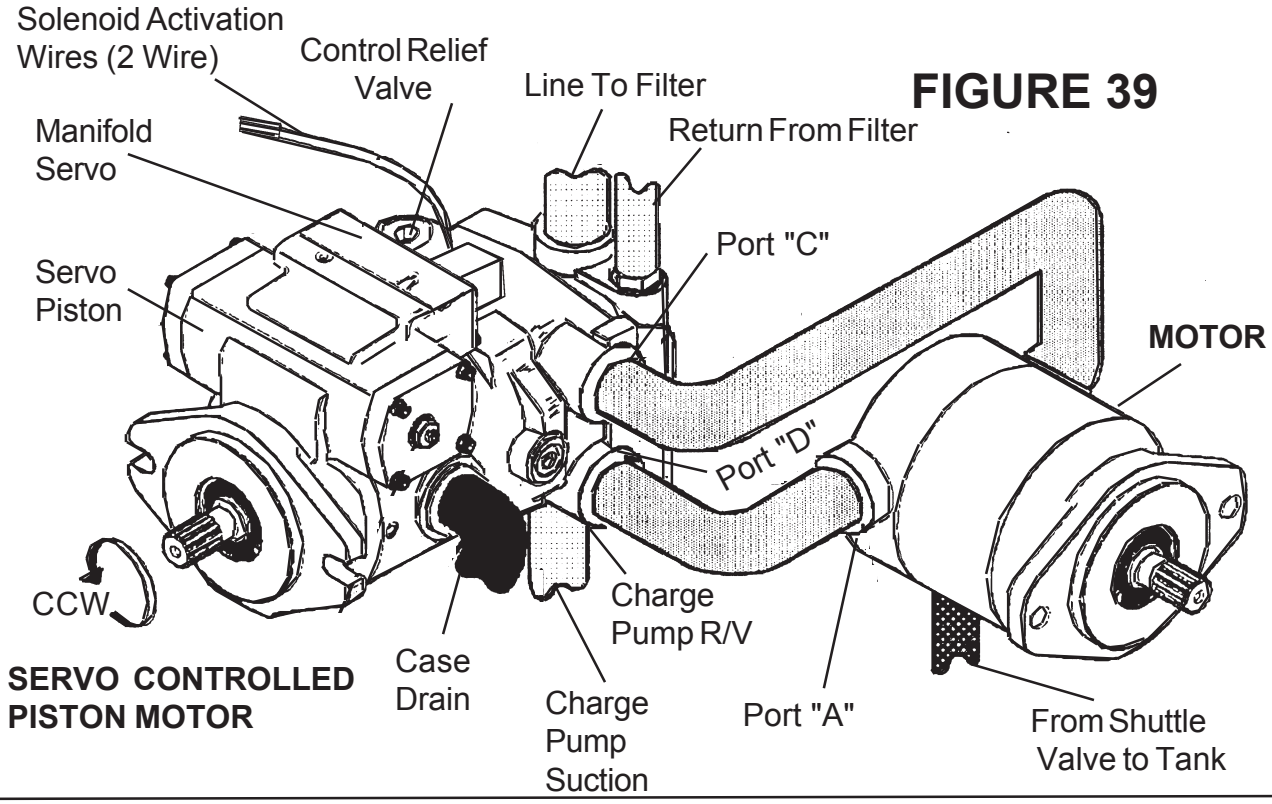

FIGURE 39

The Motor Circuit is engaged by two Manually Operated Switches (See Figures 36, 37, & 38 in Motor Repair Section for Types Used). These Switches have varied from “On - Off” to “Momentary’, But all have served the same purpose. Closing the Switches completes a Circuit through the Solenoid. The Purpose of a “Solenoid” is to actuate a Pump Control, which actuates a Valve to turn on the Pump; this has varied some over the years. This movement causes the Camplate in the Pump to move. Movement of the Camplate when the Pump is turning causes the length of Piston Stroke to Change, Causing Oil to too be moved. The Greater the Angle, the longer the stroke, The longer the stroke the more Oil is Pumped, and the more oil pumped means faster the motor turns.

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PUMP CIRCUIT - MOTOR ENGAGE

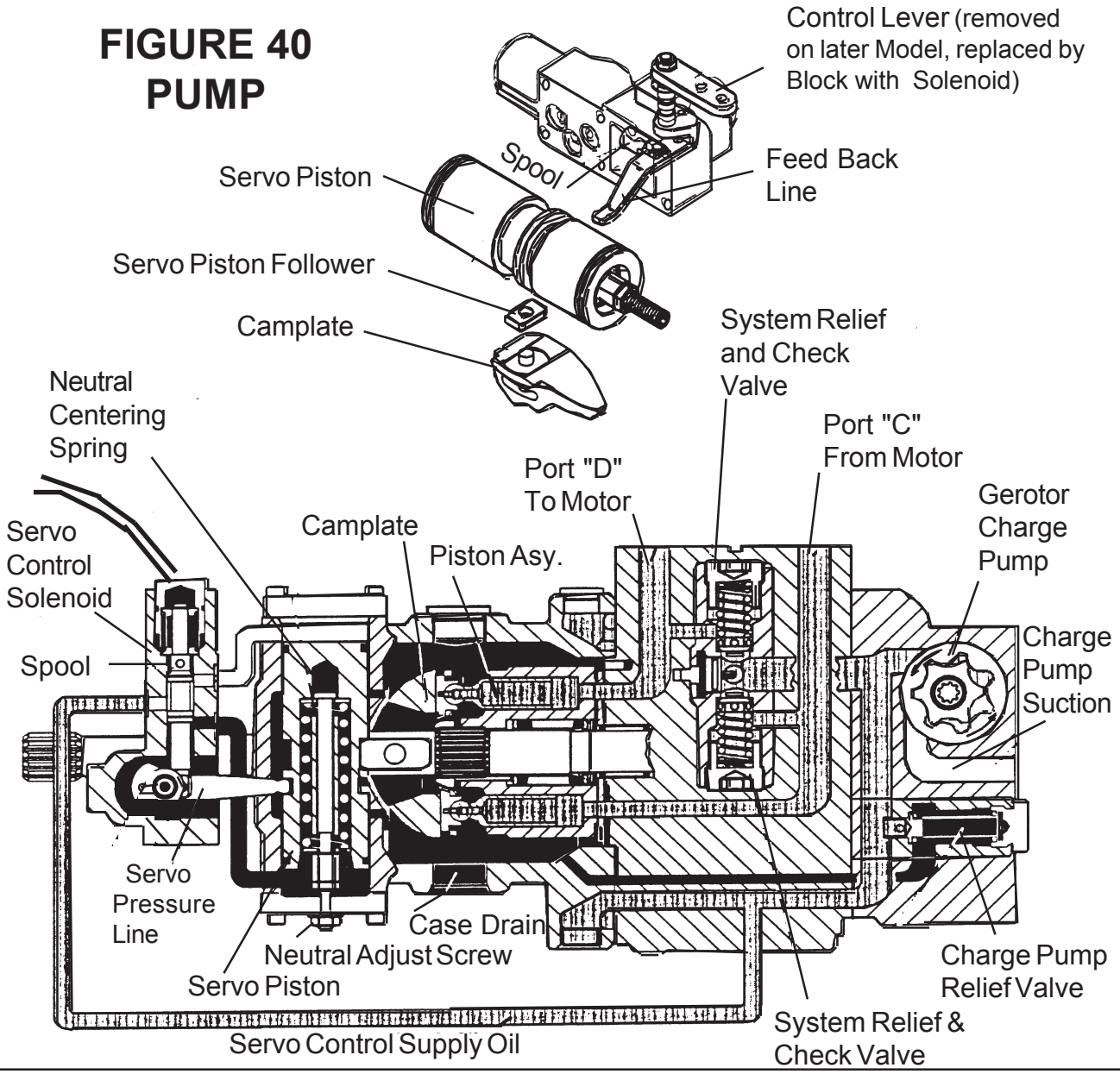
Note: The Servo Control System, (Changed see "Note" on Previous Page)

Movement of the Variable Displacement Pump Control Lever (Figure 40) starts pump Output. As Lever is rotated, it moves the Spring centered Servo Control Spool first. Movement of the Spool allows Charge Pump Oil past the Spool to one side of the Servo Piston (Figure 40). The Pressurized Servo Piston pushed against the Camplate (figure 40) causes the Camplate to rotate to a Pre-Set Angle. Oil from the opposite end of the Servo Piston is exhausted to the Pump Housing through the Control Valve Spool.

When the Control Lever (Solenoid & Block on Current Models) is returned to the Neutral position, The Spool centers itself, allowing the Pressure on both ends of the Servo Piston to equalize. The Piston and. Camplate return to a Neutral position and Oil flow from the Piston Pump ceases.

Orifices between the Control Valve and the Servo Piston control speed of the Camplate movement. Neutral Adjustment Screw is to set Servo in Neutral position to prevent flow to motor, a Buzz Bar Head will have a screw on both sides. Rotary head shown below.

FIGURE 40
PUMP



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PUMP CIRCUIT - MOTOR DIS-ENGAGE

Motor Circuit Disengage (w/ Engine Running)

The Alamo Closed Loop Motor Circuit ic considered to be Neutral when there is no output being generated by the Variable Displacement Pump, as the Shaft, Internal components and Charge Pump are being driven by Tractor Engine. The Canplate is in the centered position and the length of Stroke of the Pistons is equal, therefore there is no flow being generated by the pump

At this point the Charge Pump is drawing Oil through a Suction Screen from the Tank to provide flow to perform the following functions.

1. Keep the Circuit Primed and make up internal leakage.
2. Maintain Back Pressure on Pump asnd Motor Pistons
3. Operate Control Funtions to Start Pump.
4. Maintain Temperature Control, to prevent Oil Heating in Pump.

Oil from the Charge Pump is directed to two dual pupose system Relief and Check Valves (Figure 41). Since the Charge Pressure is greater than the pressure in either side of the Closed Loop , The Check Valves open and charged Oil (at Charge Pressure) is available to both sides of the closed Loop. When the System is primed, any excess Oil is relieved through the Charge Pump relief Valve, which maintains a pressure of 250 to 300 PSI.

The Piston Pump remains in Neutral as long as the Camplate remains in the centered position, this is controlled by the Servo Control System, If Pump does not stay in neutral check the Neutral Adjusting screw. This is usually noticed by Motor wanting to run.

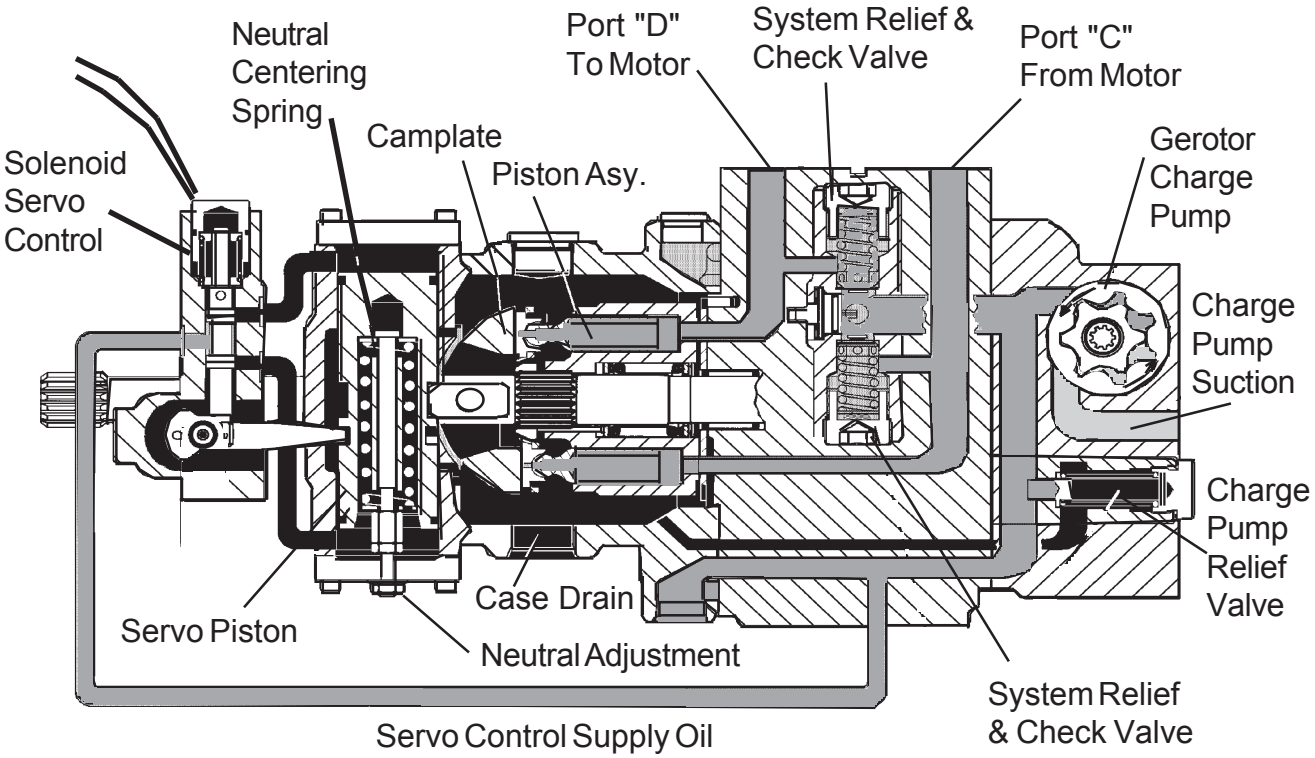

FIGURE 41 PUMP

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MOTOR CIRCUIT - PUMP ENGAGE

Motor Circuit Engaged (w/ Engine Running)

When the Switch and Solenoid are activated, The Servo control System moves the Camplate to its Maximum Angle. As the Piston Block rotates, The Angle of the Camplate causes the Pistons to move in and out of thier Bores as they follow the Camplate, This results in Oil being drawn into the Piston Bore as the Piston is pulled outward, and Oil being expelled into the other side of the Loop as the Piston is forced back into its bore, This creates the flow of Oil necessary to power the Motor. Movement of the Camplate angle from the neutral to maximum is set a approximatly 6 seconds and is controlled by the size of the Orfice between the Control valve & Pump Case.

Oil under charge pressure is available at the Check Seats of the combination System Relief & Check Valves. As the Piston is drawn outwards in its bore, The combination of lower pressure in the Piston Bore and charge pressure in Port "C" causes the Check Valve for Port "C" to come off its seat, Allowing Oil At Charge pressure to fill the Piston Bore. As the Piston Block rotates the Oil is trapped in its bore by the Valve Plate. As the Piston Block rotates more, the piston is forced back into its bore expelling the Oil into Port "D" through an opening in the Valve Plate. The Higher pressure in Port "D" seats the Check Valve for Port "D", Seperating Oil in Port "C" frpm Oil in Port "D". Oil is forced to go through the Motor causing Motor Rotation.

Any Leakage from the Piston Block Valve Plate, Pistons, or excess Oil from the Charge Pump Relief Valve is vented to the case and is returned to Tank through the case Drain Port.

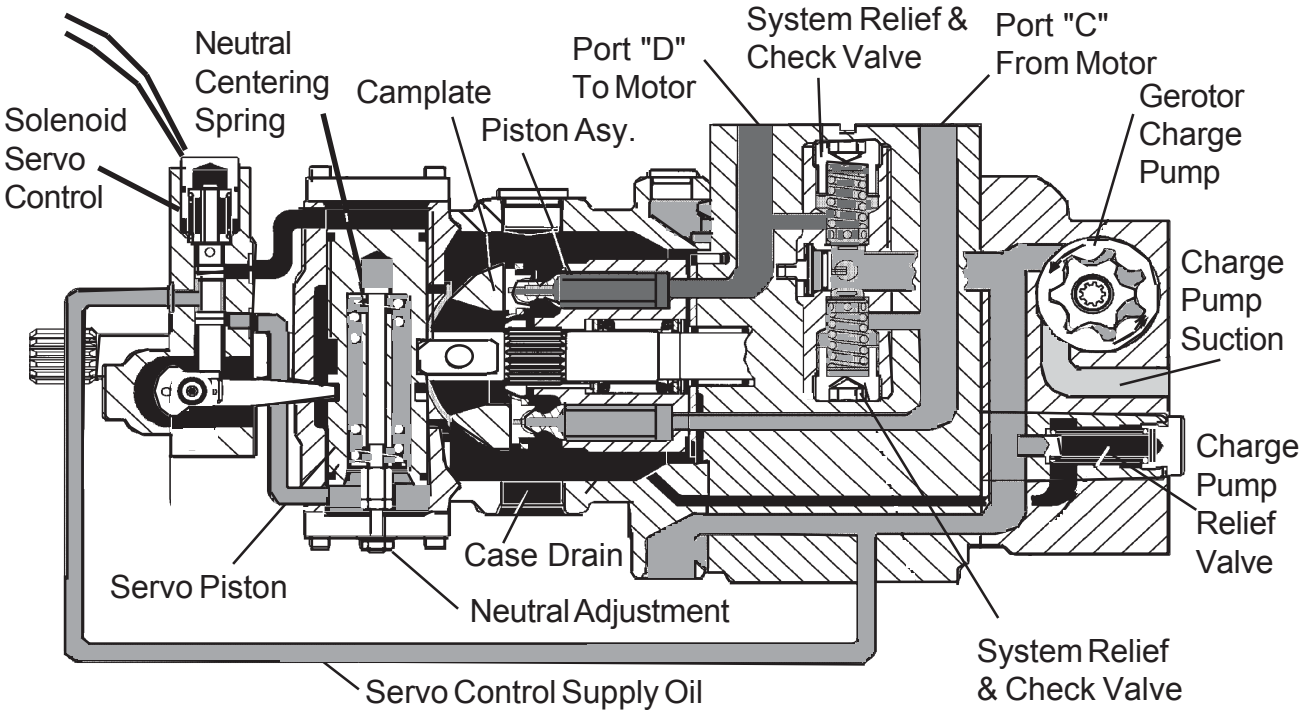

FIGURE 42 PUMP

Relief Valve Operation:

When the pressure in Port "D" exceeds the setting of the Relief Valve (4500 PSI), the large Spring in the Relief Valve is compressed, Opening an Orfice allowing excess Oil to relieve into the Charge Circuit, Since the Check Valve for Port "C" is open, The Oil is available to the intake side of Pump

There is also a relief Valve in the High Pressure side of the Loop at the Motor. This Valve is set to relieve at 4000 PSI and is in the circuit to absorb spike pressure encountered during severe operation.

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PUMP - PARTS LOCATION

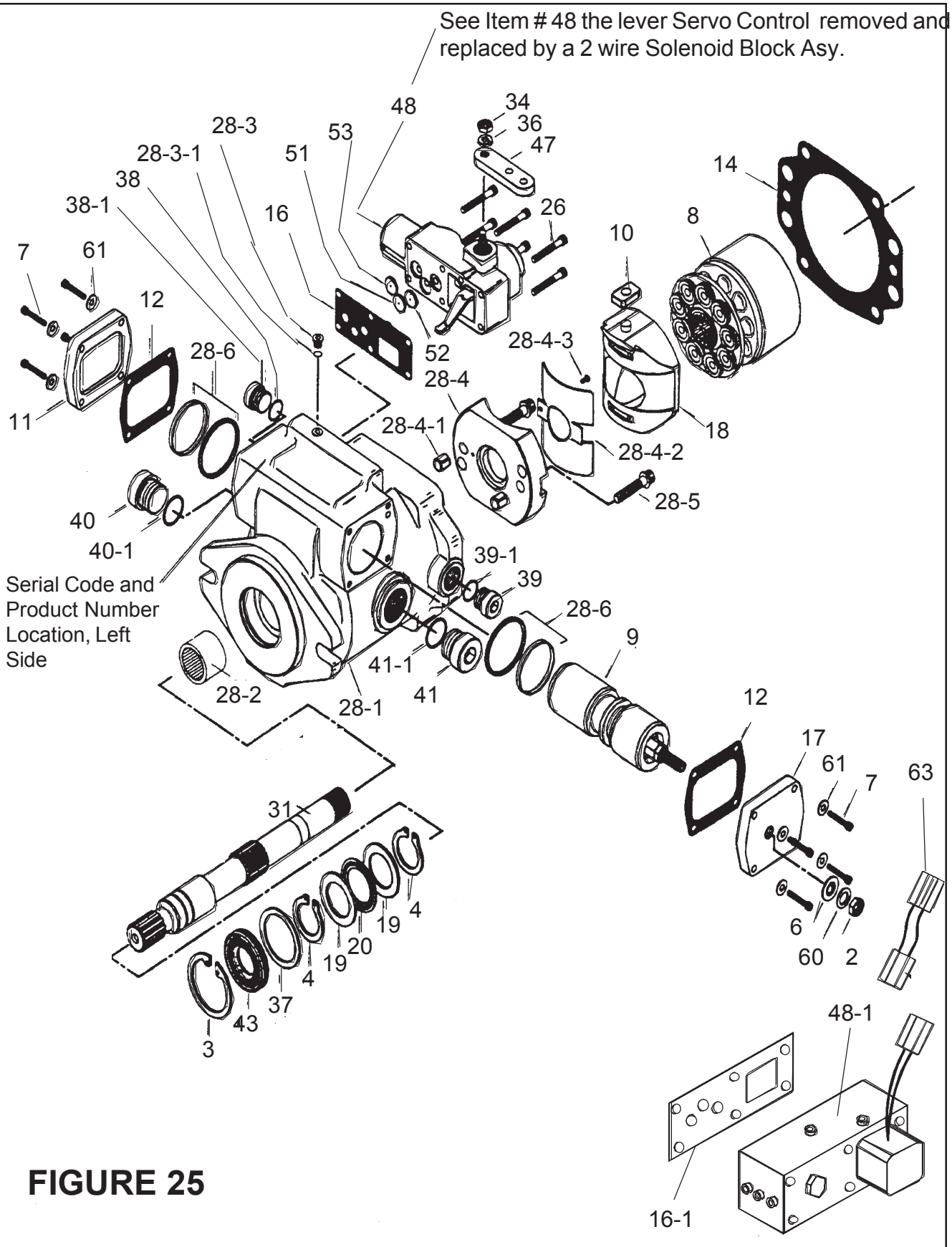

FIGURE 25

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PUMP - PARTS LOCATION

Item	Qty	Description
2	1	Jam Nut
3	1	Retaining Ring
4	2	Retaining Ring
6	1	Seal Washer
7	8	Bolt, #10-24 X 1" (25.4 mm) Long
8	1	Rotating Kit Asy.
9	1	Servo Piston Asy.
10	1	Servo Piston Follower
11	1	Cover Plate
12	2	Gasket, Cover Plate
14	1	Gasket, Housing
16	1	Gasket, Control Housing (Used 1997 & Down)
16-1	1	Gasket, Solenoid Servo Asy, (Used 1998 & Up)
17	1	Cover Plate
18	1	Camplate
19	2	Thrust Race
20	1	Thrust Bearing
21	1	Relief Valve, For Port "C"
21-1	1	O-Ring, .097" Dia. X .755" ID, (2.46 mm Dia. X 19.18 mm ID)
22	1	Relief Valve, For Port "D"
22-1	1	O-Ring, .097" Dia. X .755" ID, (2.46 mm Dia. X 19.18 mm ID)
23	4	Bolt, 3/8"-16 X 2-1/4" (57.2 mm Long)
24	2	Bolt, 3/8"-16 X 3-1/5" (88.9 mm Long)
25	2	Bolt, 3/8"-16 X 4" (101.6 mm Long)
26	6	Bolt
27	1	Valve Plate
28	1	Housing Asy (Includes Following Items)
28-1	1	Housing Only
28-2	1	Bearing, Press Fit
28-3	1	Plug, Sub-Asy.
28-3-1	1	O-Ring, .064" Dia X .239" ID (1.63 mm Dia X 6.1 mm ID)
28-4	1	Cradle Sub-Asy
28-4-1	2	Dowel Bushing
28-4-2	1	Bushing
28-4-3	1	Bolt, Button Head
28-5	2	Bolt
28-6	2	Seal, Sub-Asy.
29	1	Back Plate Asy.
29-1	1	Bearing, Press fit
29-2	1	Roll Pin

Note: If replaced with a new Pump it will be the Electric Solenoid Servo Control Type, Reference to Insert Sheet # 02970224 for Electric Servo Control Manifold Asy.

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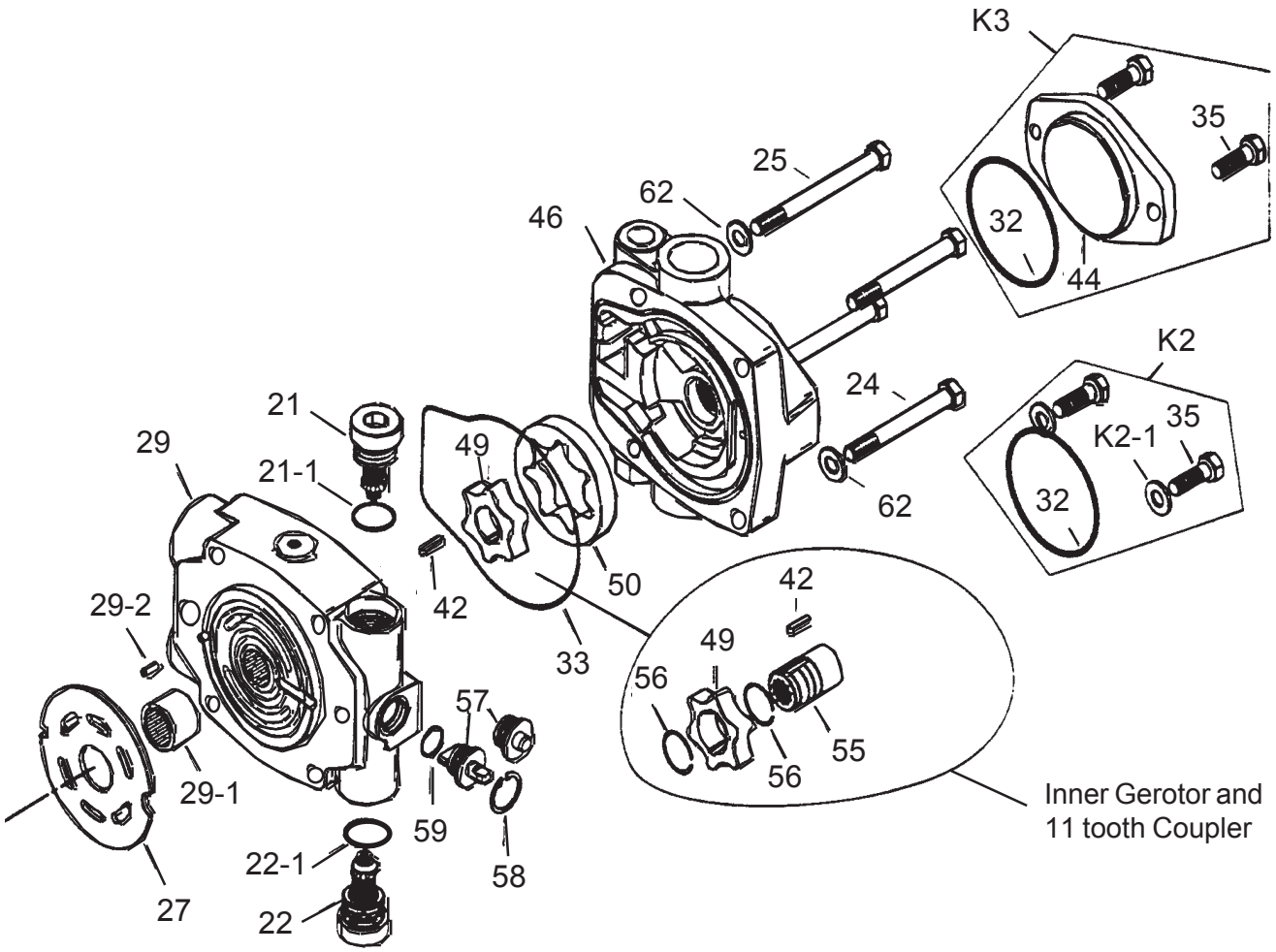
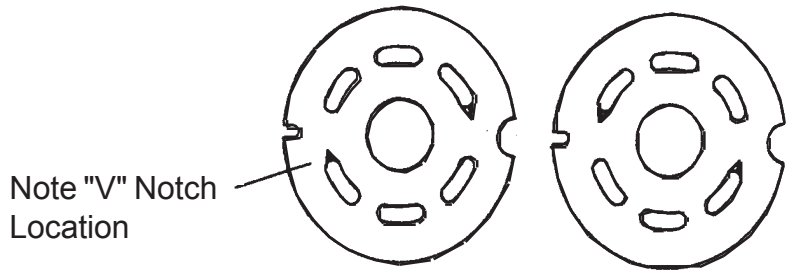
PUMP - PARTS LOCATION



VALVE PLATE
IDENTIFICATION



LH Rotation
Valve Plate
Item # 27

RH Rotation
Valve Plate
Irem # 27

FIGURE 26

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PUMP - PARTS LOCATION

Item	Qty	Description
31	1	Drive Shaft
32	1	O-Ring, .0625" Dia X 3.25" ID (1.59 mm Dia. X 82.55 mm ID)
33	1	O-Ring, Molded
34	1	Nut (Used 1997 & Down)
35	2	Bolt, 3/8"-16 X 1" (25.4 mm Long)
36	1	Lockwasher
37	1	Washer
38	1	Plug
38-1	1	O-Ring, .087" Dia. X .644" ID (2.21 mm Dia. X 16.36 mm ID)
39	1	Plug
39-1	1	O-Ring, .087" Dia. X .644" ID (2.21 mm Dia. X 16.36 mm ID)
40	1	Plug
40-1	1	O-Ring, .116" Dia. X .924" ID (2.95 mm Dia. X 23.47 mm ID)
41	1	Plug
41-1	1	O-Ring, .116" Dia. X .924" ID (2.95 mm Dia. X 23.47 mm ID)
42	1	Key
43	1	Cover Plate
44	1	Shaft Seal
46	1	Charge Pump Adapter Asy.
47	1	Control Arm (Used 1997 & Down)
48	1	Manual Servo Control Asy.(used 1997 & down)
48-1	1	Solenoid Servo Control Manifold Asy, (Used 1998 & Up) Not Shown
49	1	Inner Ring Gerotor
50	1	Outer Ring Gerotor
51	1	Supply Orfice
52	1	Control Valve Orfice
53	1	Control Arm Orfice
57	1	Dump Valve Actuator of Plug
58	1	Retaining Ring
59	1	Quad Ring .062" Dia. X .625" ID (1.59 mm Dia. X 15.9 mm ID)
60	1	Washer
61	8	Washer
62	3	Washer
63	1	Adapter Wire Harness, 3 wire to 2 wire (P/N 02970201) used only when converting pre-1997 units to later Pumps. See Insert Sheet # 02970224 for instructions.

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PUMP DIS-ASSEMBLY:

The following instructions apply to a single Servo Controlled Piston Pump with or without Gerotor Charge Pump. A Tandem Pump Assembly should be separated into individual Pumps before dis-assembly

1. Position the Pump into a protected Jaw Vise (make sure Vise is Clean), Clamping onto the outer portion of the flange (DO NOT OVER TIGHTEN IN VISE), with the Bolts up, Mark the relationship of the working Ports (for re-assembly identification) to the Servo Control Assembly with a Scribe (Make a Line). Remove the four bolts retaining the Back Plate. (If no Gerotor Charge Pump Skip to Step 6).
2. Lift the Charge Pump Adapter Assembly straight up off Back Plate, Shaft and Gerotor. Gerotor may stay in adapter or on Back Plate.
3. Remove O-Ring from Charge Pump Adapter.
4. **Remove Outer Gerotor Ring** from either the Charge Pump Adapter of the Inner Gerotor Ring.
5. **Remove the Inner Gerotor Ring** and Key from the Drive Shaft or Inner Gerotor Ring and Coupler Assembly from Shaft.
6. Lift Back Plate straight up off Shaft and Housing. Remove Valve Plate from Back Plate or from rotating Kit Assembly, Still in Housing.
7. From Back Plate, remove Dump Valve Retaining Ring, Dump Valve or Plug, and Relief Valve Assemblies. NOTE: Mark the Relief Valve in relationship to the Cavity it was removed from, for Re-Assembly purposes.
8. **Back Plate inspection** (See Figure 27).
   Check the Bearing (Press Fit) in Back Plate, If Needles remain in cage, Move freely and settings is at the Dimension shown in Figure 27, removal of Bearings is not required. Check Roll Pin in Back Plate, If tight and set to dimensions shown in Figure 27 , removal is not required.

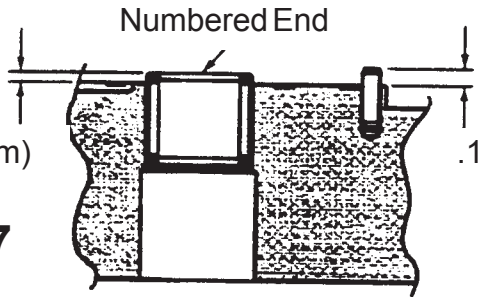

FIGURE 27

9. Remove Housing Gasket from Housing of Back Plate.
10. With Pump Still in Vise, remove the six Bolts retaining the Manual Servo Control Assembly (or Solenoid Servo Assembly 1998 & Up). Remove the Control Assembly and Control Housing Gasket from the Housing, remove the Orifice Plates noticing the Location for Re-Assembly. Remove Nut and Lock Washer from control Arm, Note position of Control Arm for Re-Assembly on Manual Servo Assembly (1997 & Down). (Refer to Appendix B for Dis-Assembly and Inspection of Control Assembly)
11. **To remove Rotating Kit Assembly** from housing first remove Pump from Vise holding the Rotating Kit assembly in position. Lower Pump so that the Shaft end (Flange End) is up. Set the rear of Housing onto table with Housing flat and Rotating Kit Assembly at rest on table. (Hole in table for protruding Shaft is required). Lift and remove the Housing and Shaft from Rotating Kit Assembly and Camplate.

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12. **Remove Camplate** from rotating kit Assembly and Servo Piston follower from Camplate. (Refer to Appendix C for dis-assembly and inspection of Rotating Kit).
13. **Camplate Inspection**, The Finish on the Piston Shoe Surfaces of the Camplate should show no signs of scoring at all. Inspect Camplate Bushing surface for wear and surface for coating transfer from Bushing.
14. **To remove Servo Piston Assembly** from Housing start with the four bolts and washers retaining each cover plate.
15. In removing the Cover Plate from the Servo Piston Bolt. Remove Jam Nut, Washer and Seal Washer. Hold the Servo Piston Plate with Hex Key and unscrew Cover Plate off Bolt.
16. **Remove Servo Piston Assembly** and Seal Sub-Assemblies (Two Sets) from Housing. Note: Dis-Assembly of Servo Assembly is not required.
17. Remove retaining Ring from the Cover of the Housing. Press the Shaft, Shaft Seal or Spacer and Washer from Housing, Remove Retaining Ring Thrust Washer, Thrust Bearing, Second Thrust Washer and second Retaining Ring from Shaft.
18. **Housing Inspection** (See Figure 28), Check the Bearing (Press Fit) in Housing. If needles remain in cage, move freely and set at the dimension shown in Figure 28, Removal of Bearing will not be required.

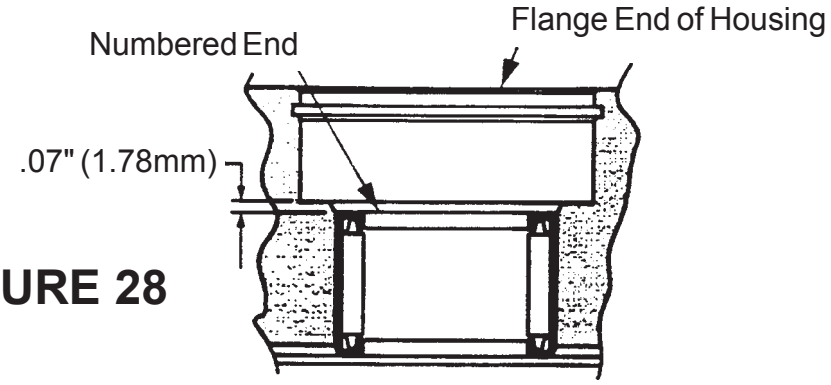

FIGURE 28

19. **To remove Cradle Sub-Assembly** remove the two Bolts retaining Cradle inside Housing. Move the Cradle Sub-Assembly back-an-forth to release Dowel Bushing and removing Cradle Sub-Assemblies from Housing.
20. Remove Button Head Bolts to remove Bushing from cradle.
21. **Bushing Inspection,** Inspect bushing for contamination embodiment within Coating of Bushing surface coming in contact with Camplate.
22. **Remove All Plugs from Housing,** This for inspection to make sure contamination is not caught under plugs or in passages.
23. **Discard Parts**, This will include, The Shaft Seal and all O-Rings from all assemblies, Replace with new ones; **NEVER** use old Seals to assemble Pump.

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PUMP RE-ASSEMBLY:

The following instructions apply to a single Servo Controlled Piston Pump with or without Gerotor Charge Pump. A Tandem Pump Assembly should be separated into individual Pumps before dis-assembly and assembled back the same way.

1. All Parts should have been cleaned and critical moving parts lubricated as described in Steps below Before Starting Re-Assembly. (Also Listed in Previous Introduction Page)

- **A.** After dis-assembly of Pump wash all metal components in clean solvent.
- **B.** Use compressed Air to dry parts after washing (Compressed air must be filtered and moisture free). DO NOT wipe them dry with Paper Towels or Cloth as these will leave lint and/or dust contamination. DO NOT USE Compressed Air to Spin any component (such as Bearings or Plates) as this will damage or Blow them apart. Secure any part before using compressed Air to dry it.
- **C.** Always use new Seals when re-assembling Hydraulic Pumps, Lubricate the new rubber Seals with a Petroleum Jelly, (Vaseline) before installing them.
- **D.** DO NOT reinstall worn or damaged Parts back in Pump, DO NOT use a worn or damaged Pump Housing.

2. If Bearings are being replaced in Housing Press them in now, See Figure 28 for dimension on how far to press them in, This is a critical dimension and make sure the numbered end of Bearing is pointing outward.

3. Install the two new Seal Sub-Assemblies into the Servo Piston cavity of Housing

4. **Screw the Cover Plate onto the Servo Piston Assembly**, Install new Cover Plate Gasket in place on Housing. Install Servo Piston Assembly and Cover Plate into Servo Piston bore in right side of housing (as shown in Figure 29). Retain Cover Plate with four each Washers and Bolts, Torque these Bolts to 40 to 48 in. lbs. (4.5 to 5.4 nm).

5. **Servo Piston Neutral Adjustment,** Centering the Servo Piston Assembly is required. Measure in from the left side and set Servo Piston .5" (12.7 mm) from the surface of Housing Servo Bore as shown in Figure 29. (Final adjustment may be require after Pump is installed and operating to obtain Neutral). Special Note: if Unit is equipped with Buzz Bar Head it will have a Neutral (Centering) Adjustment on one side of Servo Piston and piston travel limiting Screw on the other side.

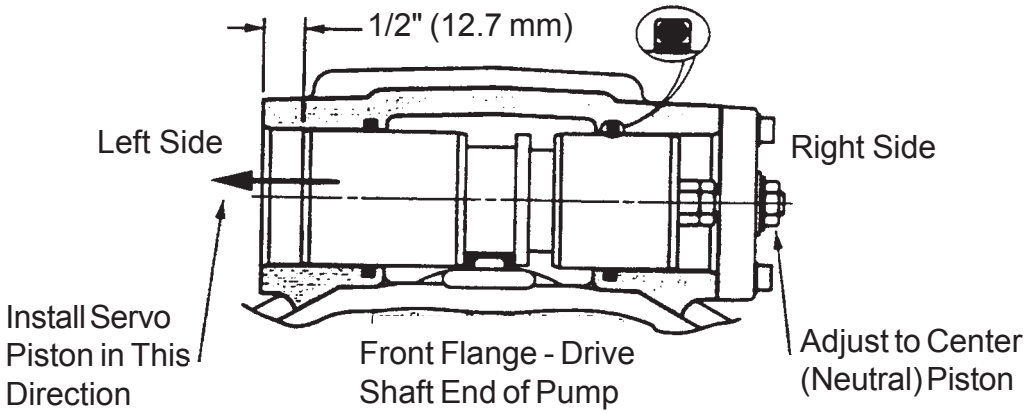
1/2" (12.7 mm)
Left Side
Right Side
Install Servo Piston in This Direction
Front Flange - Drive Shaft End of Pump
Adjust to Center (Neutral) Piston

FIGURE 29

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6. **Install New Seal Washer**, Washer and Jam Nut to Servo Piston Bolt (Only do this after Centering of Servo Piston has been done). Holding Servo Piston Bolt with Hex Key Wrench Torque Jam Nut to 150 to 160 in. lbs. (17 to 18 nm). Recheck Servo Piston Measurements (See Figure 29) If Measurement is OK install Cover Plate and Cover Plate Gasket on Left Side of Servo Piston, Retain cover with 4 each of # 10-24 Bolts, Torque these Bolts to 40 to 48 in. lbs. (4.5 to 5.4 nm). Note: If on Buzz Bar Head units there is Flow Limiter Bolt and Nut added in LH side cover plate, this looks like the Adjusting Centering Bolt on RH Side. This adjusting bolt on the LH side cover is only to limit the Flow to the Buss Bar Head. The Left Hand side cover is added as Servo Piston Travel Limiting Adjusting Bolt.
7. **To Assemble Cradle Sub-Assembly**, Press Dowel Bushing into Cradle and install Bushing into Cradle retaining with Button Bolt. Torque Button Bolt to 14 to 16 in. lbs. (1.6 to 1.8 nm).
8. **Place Cradle Sub-Assembly into Housing making** sure Dowel Bushings and Cradle is completely seated into Housing. Retain Cradle Sub-Assembly with two Bolts that have Locktite # 277 (or equivalent) applied to the end of the threads. Torque these Bolts to 25 to 28 in. lbs. (34 to 38 nm)
9. **To Install Shaft Components,** Place Exterior Retaining Ring, Thrust Race, Thrust Bearing, Second Thrust Race and second Retaining Ring onto Shaft. Position Washer and Shaft Seal or Spacer onto Shaft.
10. **Install Servo Piston Follower onto Camplate Dowel Pin**, Install Camplate carefully onto Bushing (Coat Bushing Surface with Hydraulic Oil), Aligning Servo Piston Follower with Slot in Servo Piston Assembly. (Refer to Appendix C for Re-Assembly of Rotating Kit Assembly).
11. **To Install Rotation Kit Assembly**, Leave Housing and Shaft in the Horizontal position. Holding Camplate into position with Screw Driver through Controller Linkage passage-way at the top of the Housing, Place Rotating Kit Assembly over shaft and into Housing until Pistons are in against Camplate. Make sure all parts are in Housing completely and properly positioned. Return the Pump to the Vise with open end of Housing up. Clamping Housing on the outer portion of the flange.
12. **Install Gasket on Housing**, Install New Gasket on Housing now.
13. **If necessary, Press New Bearing and Roll Pin in to Back Plate** to dimension shown in Figure 34. Bearing MUST be installed with the numbered end of Bearing Outward. Roll Pin must be installed with split in Roll Pin away from Bearing.
14. **Install Relief Valve**, Always Install New O-Rings on Relief Valves, Install Relief Valves in its original cavity in Back Plate that it was taken out of is recommended, but if they are switched it should not affect anything as they are both the same setting. Torque Relief Valves (Tighten) to 100 to 110 ft. lbs. (136 to 149 nm).
15. **Install New Quad Ring on Dump Valve or Plug**, Install Dump Valve or Plug and retain with Retaining Ring into Back Plate. Note: Make sure paddle of Dump Valve is perpendicular to relief valve axis prior to installing or damage could occur.
16. **Apply a small amount of Petroleum Jelly to the Steel Side of Valve Plate** to hold it in place for installation. Aligning the Index Pin, Place the Valve Plate in position onto the Back Plate with the Steel side against Back Plate.
17. **Install Back Plate Assembly into Housing Assembly**; Make sure Ports are positioned correctly, Valve Plate and Gasket stay in place. If No Gerotor Charge Pump Skip to step 22

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18. **Install Key and Inner Ring Gerotor** onto Shaft or Coupler Assembly, Lubricate Inner Ring Gerotor before Assembly. (Refer to appendix A for Re-Assembly of Charge Relief Valve in Adapter Plate).
19. **Install O-Ring and Outer Ring Gerotor** onto Adapter Plate, Lubricate both O-Ring and outer ring to hold in position during assembly of adapter plate, Install adapter plate onto Back Plate. Make sure O-Ring and Gerotor Ring stay in place.
20. **Retain Back Plate and Adapter Plate** (when used) with four Bolts, Torque these Bolts to 27 to 31 ft. lbs. (37 to 42 nm). (refer to Appendix B for Re-Assembly of Manual Servo Control Assembly).
21. **Install Control Housing Gasket onto Housing**, Install Orifices into Control Assembly and retain in position with Petroleum Jelly (Vaseline). Install Manual Servo Control Assembly onto housing making sure feed back link entered small groove in Servo Piston Assembly (Manual Servo Control on units 1997 & Down). Units 1998 & Up have Solenoid Servo Manifold Assembly to install here.
22. **Retain Servo Control Assembly with six Bolts**. Torque these Bolts to 40 to 48 in. lbs. (4.5 to 5.4 nm)
23. **Install Control Arm.** Only applies to units 1997 & Down with Manual Servo Control. Install Control Arm onto Control Assembly input Arm, Retain with Lock Washer and Nut, Torque from 4 to 6 ft. lbs. (5 to 8 nm).
24. **Install Plugs;** Install new O-Ring on all Plugs into Housing, Torque 3/4" Plugs from 21 to 24 ft. lbs. (28 to 32 nm) and torque 1-1/4" Plugs from 40 to 45 ft. lbs. (54 to 61 nm).
25. **Check all Assembly Steps** before Testing and Re-Installing Pump back on Tractor, Follow Start-Up procedures as outlined in Operators Manual. Pump MUST be Pre-Lubed prior to starting up or Pump will be damaged. This is done by putting recommended Hydraulic Oil into pump, See Specification chart for type Oil recommended. On Models (Machete) where the tank is higher than the pump the suction line will have positive Oil flow and usually Pre-Lube itself.

NOTES

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PUMP - CHARGE PUMP ADAPTER ASY

CHARGE PUMP ADAPTER DIS-ASSEMBLY:

1. **The following instructions apply to Charge Pump Adapter Dis-Assembly** (See Figure 30 & 31)
2. **Clean,** Make Sure that every thing, Pump, Connections, Tools, Work Bench, Vise and all general conditions are very clean before beginning any work.
3. **Remove** Plug, Shims, Springs, and Poppet from Adapter Assembly
4. **Inspect Charge Pump Relief Valve Seat** inside the Charge Pump Adapter. Check to insure that seat is smooth and free of Burrs or other defects or damage.
5. **Inspect the Charge Pump Relief Valve Spring**, Make sure it is not bent or broken.
6. **Inspect the Bearing or Bushing inside the Charge Pump Adapter**. The Bearing Needles must remain in the bearing Cage at dimensions shown in Figure 36. The Bushing (if used) must have no excessive scoring.

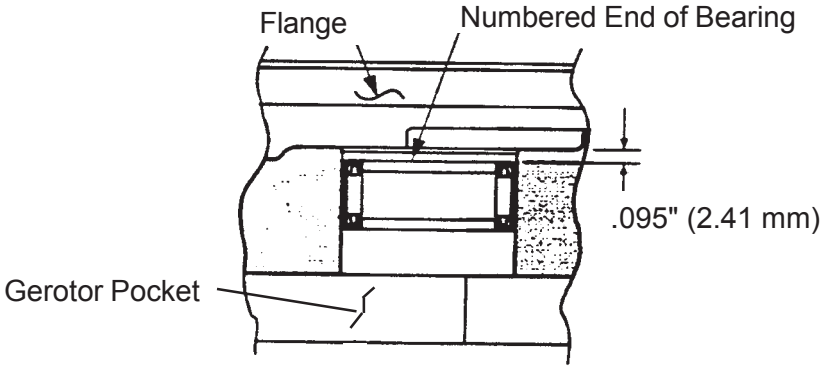

FIGURE 30

CHARGE PUMP ADAPTER RE-ASSEMBLY:

1. **New Bearing or Bushing in Adapter Assembly,** If necessary Press New Bearing or Bushing into Adapter Assembly. The Bearing must be installed to dimensions as listed in Figure 30. The Numbered end MUST be install Outward toward Flange as Shown in Figure 30
2. **The Bushing,** if used must be pressed flush to .010" (.254 mm) recessed
3. **Install Poppet,** Spring, Shims, and New O-Ring on Plug. Screw Plug into Adapter Assembly (See Figure 37). Torque Plug to 27 to 30 ft. lbs. (36.6 to 40.7 nm)

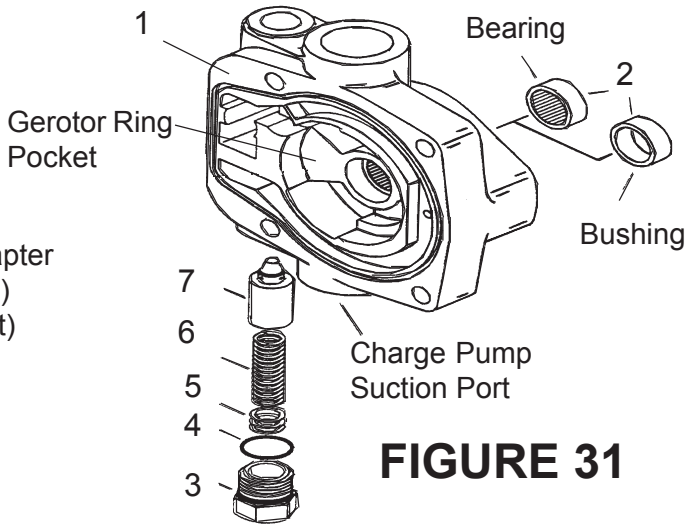

FIGURE 31

Item	Qty	Description
1	1	Chrage Pump Adapter
2	1	Bearing (Press Fit)
	1	Bushing (Press Fit)
3	1	Plug
4	1	O-Ring
5	a/r	Shims
6	1	Spring
7	1	Poppet

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PUMP - MANUAL SERVO CONTROL ASY

MANUAL SERVO CONTROL DIS-ASSEMBLY: (Used 1997 & Down)

1. **The following instructions apply to Manual Servo Control Dis-Assembly** (See Figure 32)
2. **Clean,** Make Sure that every thing, Pump, Connections, Tools, Work Bench, Vise and all general conditions are very clean before beginning any work.
3. **Input Shaft Removal,** Remove Wiper Seal (item 16) with Screwdriver. Remove Set Screw (item 13) retaining Input Shaft (item 14) and remove it from Control Housing.
4. **Valve Spool Plug,** Remove Set Screw (item 8) from Plug (item 2) retaining Valve Spool (item 7) and remove Plug. Remove O-Ring (item 3) if it did not come out with plug or remove after Valve Spool is removed.
5. **Feedback Link and Bell Crank,** Remove E-Ring (item 11) from Pin (item 10) retaining Feedback Link (item 9). Remove Feedback Link and Bell Crank from Control Housing, Head Pin (item 17) is a press fit into Bell Crank, Removal of Head Pin is not required as part of repair unless it is damaged.
6. **Valve Spool,** Remove Valve Spool (item 7) from Housing after Step 5 is done, Compress Spring (item 6) on Spool and remove E-Ring (item 4), This allows Spring Retainer (item 5), Spring (item 6) and other Spring Retainer (item 5) to slide off of Valve Spool.
7. **O-Rings and Cleaning Parts,** Make sure all O-Rings are removed from Housing, (Throw away all old O-Rings). Inspect and clean all parts, clean all Parts with Clean Solvent and Dry with Compressed Air Only (See introduction section for more cleaning information). Lubricate all parts in preparations for re-assembly.

MANUAL SERVO CONTROL RE-ASSEMBLY: (Used 1997 & Down)

1. **The following instructions apply to Manual Servo Control Re-Assembly** (See Figure 32)
2. **Clean,** Make Sure that every thing, Parts, Tools, Work Bench, Vise and all general conditions are very clean before beginning any work. Make sure all parts are lubricated.
3. **Valve Spool Spring,** Install Spring Retainer (item 5), Spring (item 6) and second Spring Retainer (item 5) onto Valve Spool (item 7). Compress Spring by pushing on outer Spring Retainer and install E-Ring (item 4) onto Valve Spool.
4. **Valve Spool,** Install Valve Spool assembled into Control Housing (item 1) making sure that the metering notches (See Figure 32) are facing outward and can be seen through the Metering Ports, Check the notches at this time, if the notches cannot be seen it will not work.
5. **Feedback Link and Bell Crank,** Bell Crank (item 12) should have Head Pin (item 17) already installed. Position Bell Crank in Housing, Slide Feedback Link (item 9) into position between Clevis on Valve Spool aligning holes, install Retaining Dowel Pin (item 10) and E-Ring (item 11).
6. **Input Shaft,** Install New O-Ring (item 15) onto Input Shaft (item 14), Hold Bell Crank in position with Feedback Link Slot and align Splined Hole of Bell Crank with Input Shaft Cavity. Install Input Shaft into Control Housing and Bell Crank. Apply Locktite # 242 or equivalent to Set Screw (item 13) and install it to retain Input Shaft. Tighten Set Screw till it bottoms out against Input Shaft and then back it out 1/4 turn.
7. **Wiper Seal,** Install Wiper Seal (item 16) on Input Shaft and seat into Control Housing.
8. **Valve Spool Plug,** Install New O-Ring (item 3) onto Valve Spool Plug (item 2) and install Plug, Tighten Plug till there is no play in Valve Spool with Input Shaft held stationary. Lock in place with Set Screw (item 8), Torque Set Screw to 17 to 25 in. lbs. (2 to 3 nm)

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PUMP - MANUAL SERVO CONTROL ASY

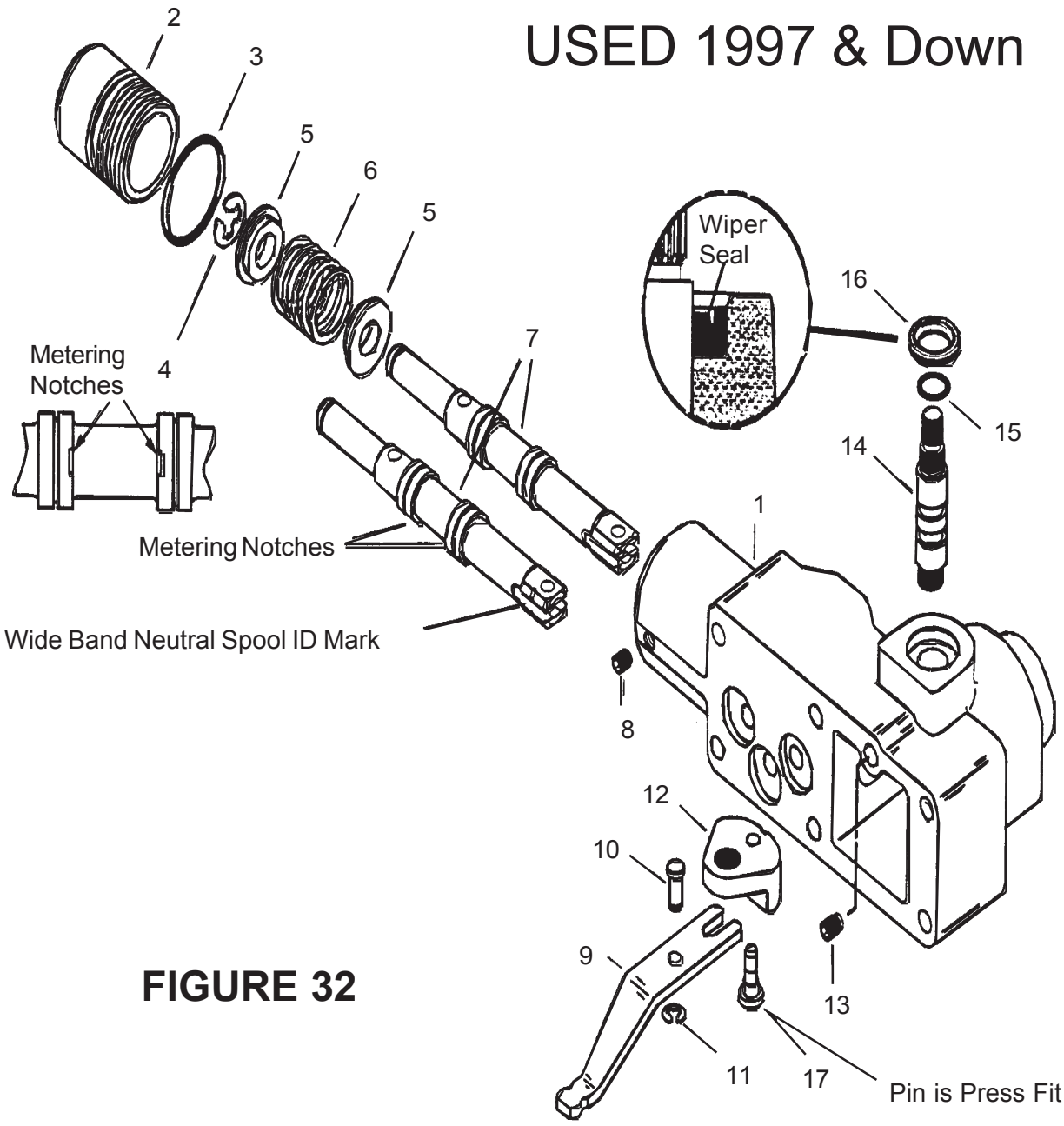

FIGURE 32

NOTE: SOLENOID SERVO CONTROL MANIFOLD ASSEMBLY, (Used 1998 & Up See Figure 39), The Manual Servo Control Assembly Shown in Figure 32 was used through 1997, at which time it was replaced by a Solenoid Servo Manifold, There are not really any repairs to be done to this later version, other than replacing the complete manifold assembly or the Solenoid. Also many of the earlier units were upgraded to this later Manifold by using up-grade Kit # 02970206 See Pump Conversion Kit Insert Sheet # 02970224 (See Figure 33 on next pages).

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PUMP - SERVO CONTROL MANIFOLD ASY

USED 1998 & Up

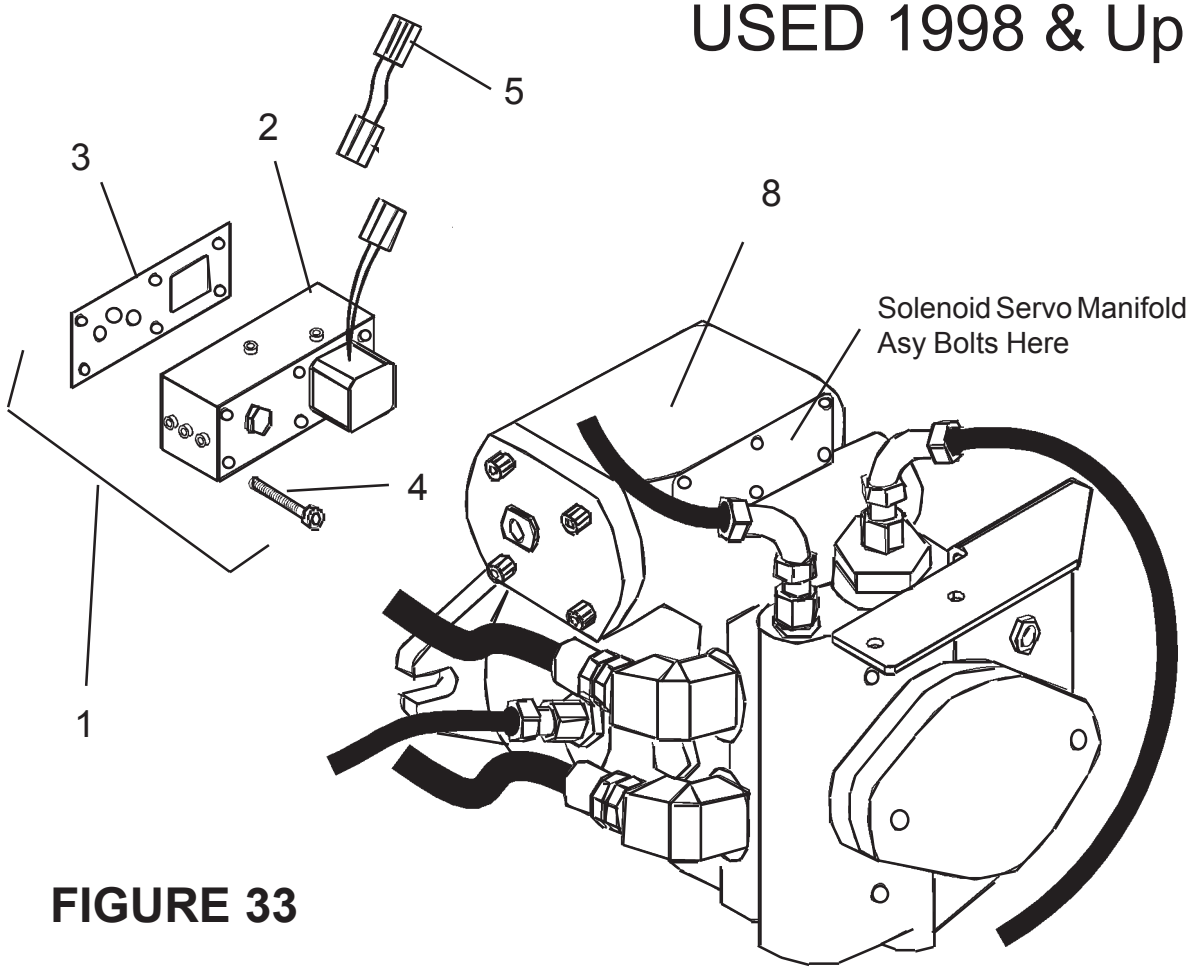

FIGURE 33

Solenoid Servo Control Manifold Assembly

Item	Part No.	Qty	Description
1	02970206	1	Solenoid Servo Control Manifold Kit (w/ items 2 through 7)
2	02970207	1	Solenoid Manifold Assembly w/ Solenoid
3	02970209	1	Gasket
4	02970208	6	Bolt
5	02970205	1	Wire Harness Adapter 3 wire to 2 (only used if converting old style Manual Servo to Solenoid Type.
6	02970201	1	Decal Instructions (Not Shown)
7	02970224	1	Insert Sheet for Conversion (Not Shown)
8	02969527	1	Pump Assembly w/ Item # 1 (New Pump)
	02969527RB	ref	Pump Assembly w/ Item # 1 (Re-Built Pump)

NOTE: Listed above (Item 1) is a Conversion Kit to convert old style Manual Servo Control to New Style Solenoid Control Servo, Also listed is Pump Assembly Complete, To Convert over and use the Wire adapter will have to be used.

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PUMP - ROTATING KIT ASY

ROTATING KIT DIS-ASSEMBLY: (See Figure 34)

1. **The following instructions apply to Rotating Kit Assembly Dis-Assembly**
   Dis-Assembly of Rotating Assembly is required for inspection Only, There are no repairable Parts that can be replaced. (See Figure 34)
2. **Clean,** Make Sure that every thing, Tools, Work Bench, Vise and all general conditions are very clean before beginning any work.
3. **Inspection,** Examine the outside diameter of the Pistons for finish condition. They should not show wear or deep scratches, Inspect the shoes for a snug fit on the ball end of the Pistons and a flat smooth surface that comes in contact with the Camplate. DO NOT LAP the Piston Shoes. (Do Not Lap means do not sand, file or try to smooth machined surface).
4. **Piston Shoes,** If Piston Shoes are rough DO NOT LAP them.
5. **Spider,** Examine Spider for wear in the Pivot area, Examine Pivot to insure smoothness and no signs of wear.
6. **Piston Block,** Inspect the Piston Block surface that makes contact with Valve Plate. This surface should be smooth and free of deep scratches, DO NOT LAP Piston Block
7. **Pistons,** The Pistons should move freely in Piston Block Bore. If they are sticky in the Bore, Examine the Bore for scoring or contamination.
8. **Pins and Spring,** To inspect Pins and Spring CAUTION should be taken in removing Spring, The Spring is highly compressed and the retaining Ring should not be removed without compressing the Spring safely.
9. **Piston Block Dis-Assembly,** The following Tools will be needed to dis-assemble Piston Block.
   A. Flat Washers, 2 ea. 3/8" ID X 1-1/8 OD
   B. Bolt, 1 ea. 3/8" X 3-1/4" NC
   C. Nut, 3/8" NC
10. **To remove Spring**, Place one of the Flat Washers over the 3/8" X 3-1/4" NC Bolt, Put Bolt through the center of the Piston Block and apply the second Flat Washer. Let the Washer rest on the three Pins and retain with Nut. Turning Nut and compressing Spring inside Block. Use a pair of Retaining Ring Pliers and remove the Internal Retaining Ring. Remove the Nut, Bolt and two Flat Washers from Block, removing the Washer, Spring, Second Washer, Three Pins and Pin Keeper at the same time.

ROTATING KIT RE-ASSEMBLY: (See Figure 34)

1. **The following instructions apply to Rotating Kit Assembly Re-Assembly**
   Re-Assembly of Rotating Assembly. (See Figure 34)
2. **Clean,** Make Sure that every thing, Tools, Work Bench, Vise and all general conditions are very clean before beginning any work. Make sure all parts are lubricated with Hydraulic Oil prior to re-assembly.
3. **To reassemble the rotating Kit Assembly** complete the following, Compress the Pin Keeper and install in Spline of the Piston Block. Install the three Pins with the Head end to the inside of the Block and position in Special grooves of the Piston Block Spline.
4. Install the Washer, Spring and second Washer into the Piston Block, Use the two 3/8" ID Flat Washers, the 38" Nut and the 3/8" x 3-1/4" Bolt to compress Spring and retain with Retaining Ring. Remove the Nut, Bolt and two washers.
5. Install Pivot onto the three Pins, Spider on the Pivot and Piston Assemblies through the Spider and into Piston Block, resting on Spider.

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PUMP - ROTATING KIT ASY

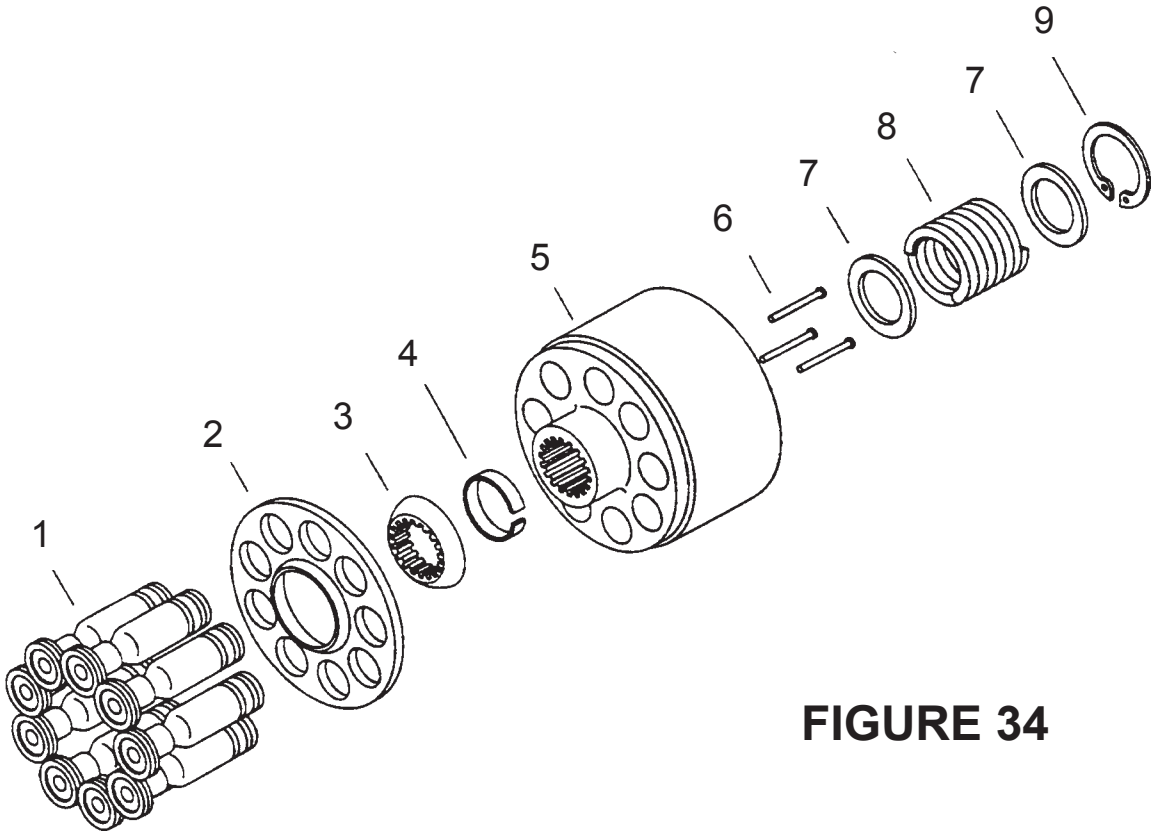

FIGURE 34

Rotating Kit Assembly

Item	Qty	Description
1	9	Piston Assembly
2	1	Spider
3	1	Spider Pivot
4	1	Retainer
5	1	Piston Block
6	3	Pins
7	2	Wsher
8	1	Spring
9	1	Retaining Ring

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Motor Circuit Section

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MOTOR CONTROL SWITCH (See Wiring Schematic in This section)

Earlier Model Machetes: FIGURE 36 (w/1 Push Pull Switch &1 Momentary Push Button Switch)

The Cutting Head Hydraulic Motor circuit is engaged by two Manually operated Switches located on the Joystick controller One is a Push Pull Switch the other is a Push Button Switch, Both Switches must be actuated in sequence before the Motor Circuit will engage. (Figure 35)

Power is taken from the Ignition Switch through a fuse to the normally open contacts on a "Push / Pull" Switch. When the Push / Pull Switch is pulled out, it completes a Circuit to the "Hold Coil" of the Solenoid located on the Pump. The "Hold Coil" does not have enough pull by itself to move the Control Lever on the Pump so a "Pull Coil" is employed. The "Pull Coil" takes power from the "Hold Coil" Circuit downstream of the Push / Pull Switch and goes to a manually closed position, A Spring Opened (Normally Open) Switch called a "Momentary Switch". When this Switch is Pushed after the Push / Pull Switch is Pulled, The Pull Coil is energized which moves the control Lever on the Pump. After the Pump has been engaged the Hold Coil will keep the Control Lever in the engaged position.

Adjustment of the Solenoid Linkage is Critical to prevent premature burnout of the Solenoid. With the Solenoid engaged, adjust the Linkage so that the Valve lever is fully actuated.

Later Model Machetes: FIGURE 37 (w/ 2 Push Pull Switches)

The Cutting Head Hydraulic Motor circuit is engaged by actuating a single On - Off Switch located on the Joystick controller. The System works in much the same way as the earlier system except that later machines utilize a Solenoid Valve with a single Coil instead of the earlier arrangement, No Momentary Switch is required.

The "Push / Pull" Switch also acts as a Neutral Start Switch for the motor Circuit, The starting Circuit of the Tractor is wired through the Switch so that the Starter Circuit is open when the Motor Circuit is Closed preventing the Operator from starting Tractor while the Motors engaged.

Current Model Machetes: FIGURE 36 (w/ 1 Push Pull Switch & 1 Lighted Rocker Switch)

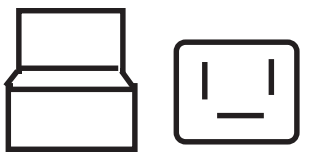
The Cutting Head Hydraulic Motor circuit is engaged by actuating a Push / Pull Switch with a built in Momentary Switch, The Momentary Switch is actuated by pulling up on Pull Knob after Push / Pull Switch has been turned on, This is a Spring loaded start and will pull it self back in when released.

ID Early Model from Late Model:

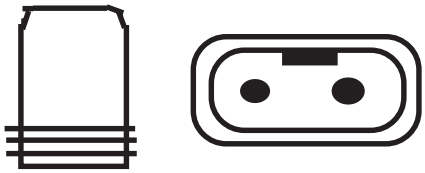
1. Look at Type Switches mounted in Joystick Console, 2 Push / Pull Switches is Early (Old) Model and 1 Push Pull Switch with 1 Lighted Rocker Switch is Later (New) Model.

2. The Pump Solenoid Connection changed from 3 Wire Connection to 2 Wire, (See Figure 35) Below for Plug Design at Pump Solenoid). The early Model Did Not use Plug.

FIGURE 35



Later Model Pump Solenoid 3 Wire Plug



Corrent Model Pump Solenoid 2 Wire Plug

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Early Model Machete Motor Circuit Wiring Schematic

w/ 1 Push / Pull Switch & 1 Momenentary Push Button Switch

S/N MB21-01001 to MB21-01107 S/N MB24-01001 to MB24-01045

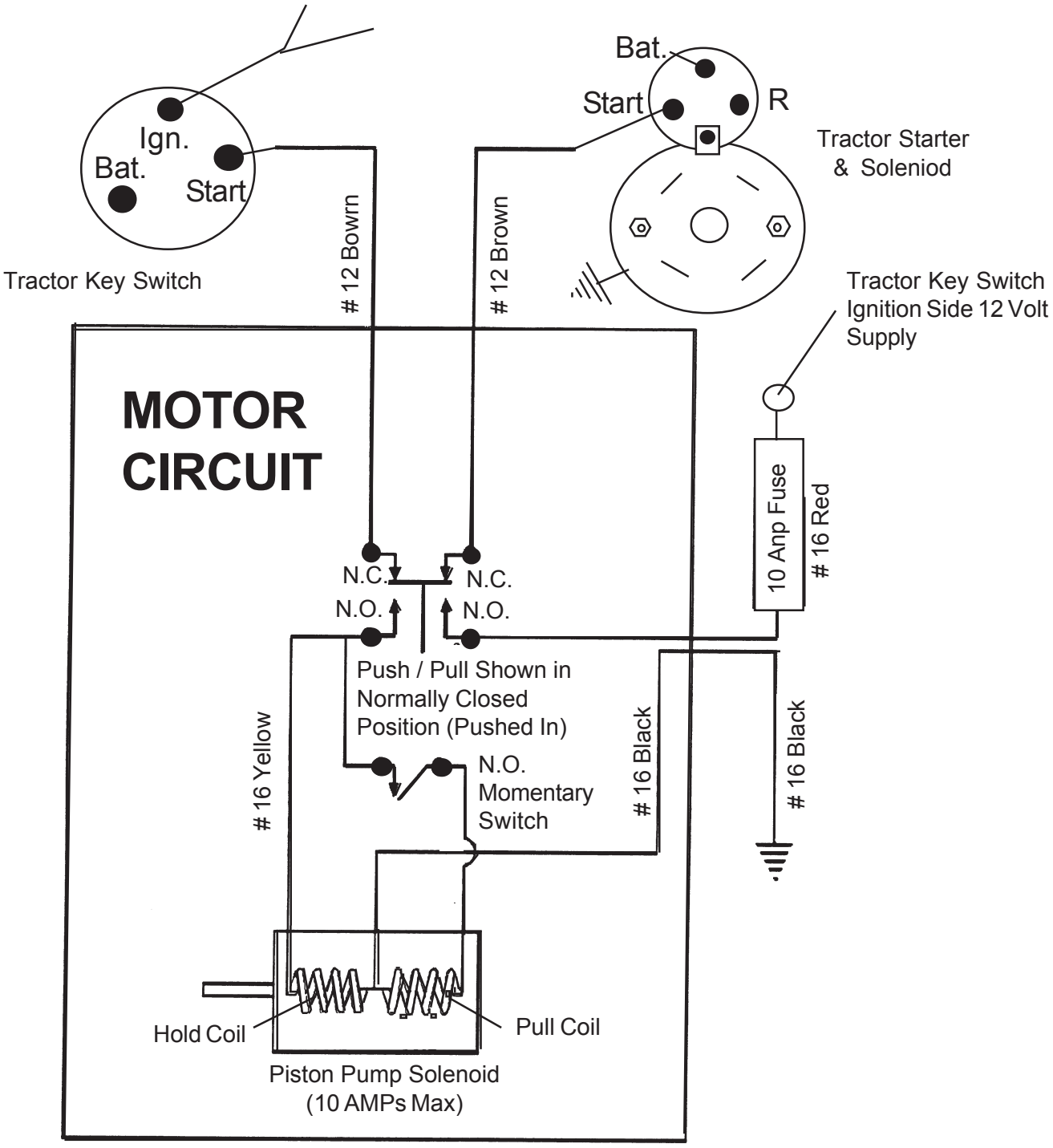

FIGURE 36

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Later Model Machete Motor Circuit Wiring Schematic

w/ 2 Push / Pull Switches Only

S/N MB21-01108 to MB21-01481 S/N MB24-01046 to MB24-01052

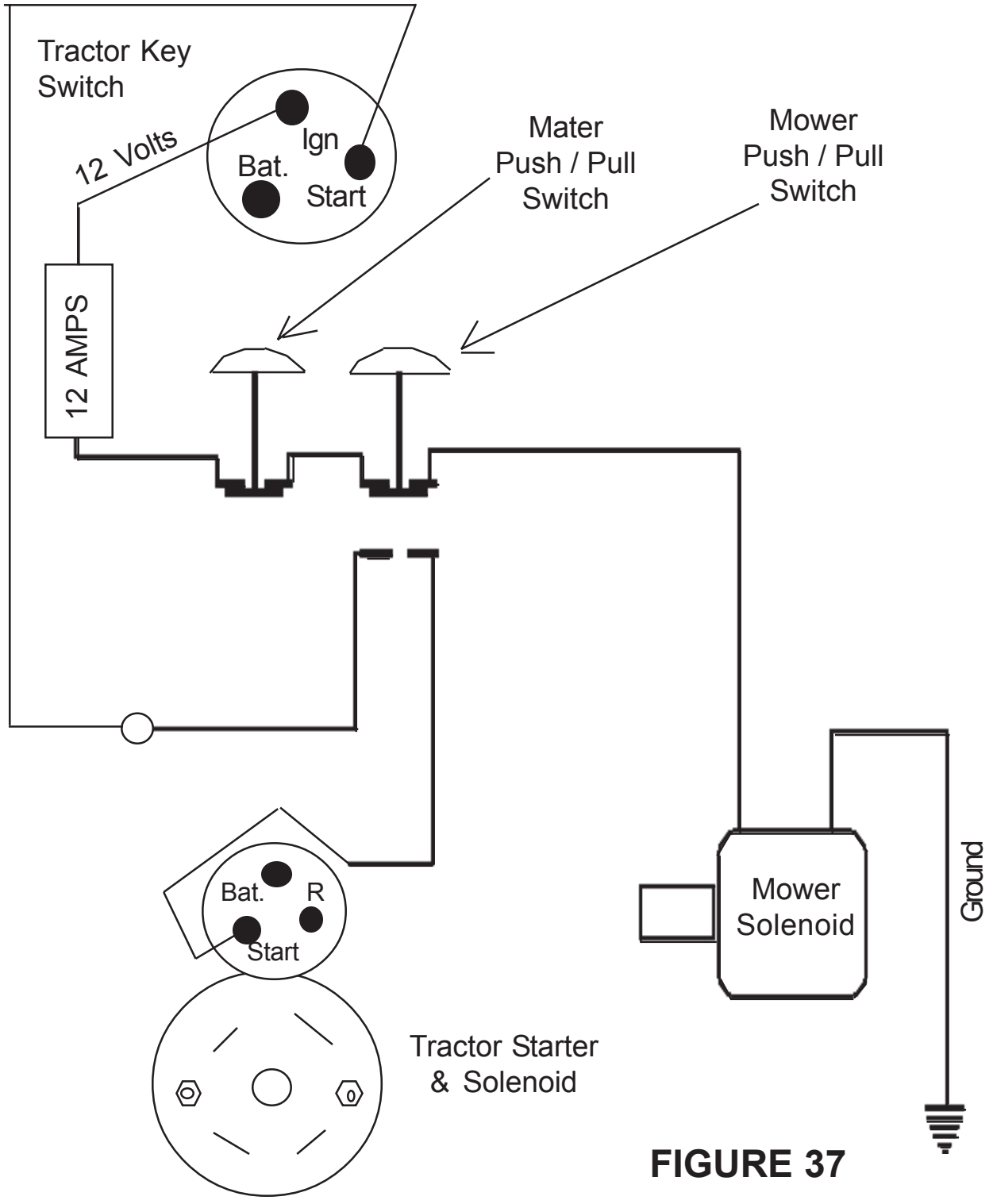

FIGURE 37

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Current Model Machete Motor Circuit Wiring Schematic

w/ 1 Push / Pull Switch & 1 Lighted Rocker Switch

S/N MB21-01482 & Up S/N MB24-01053 & Up

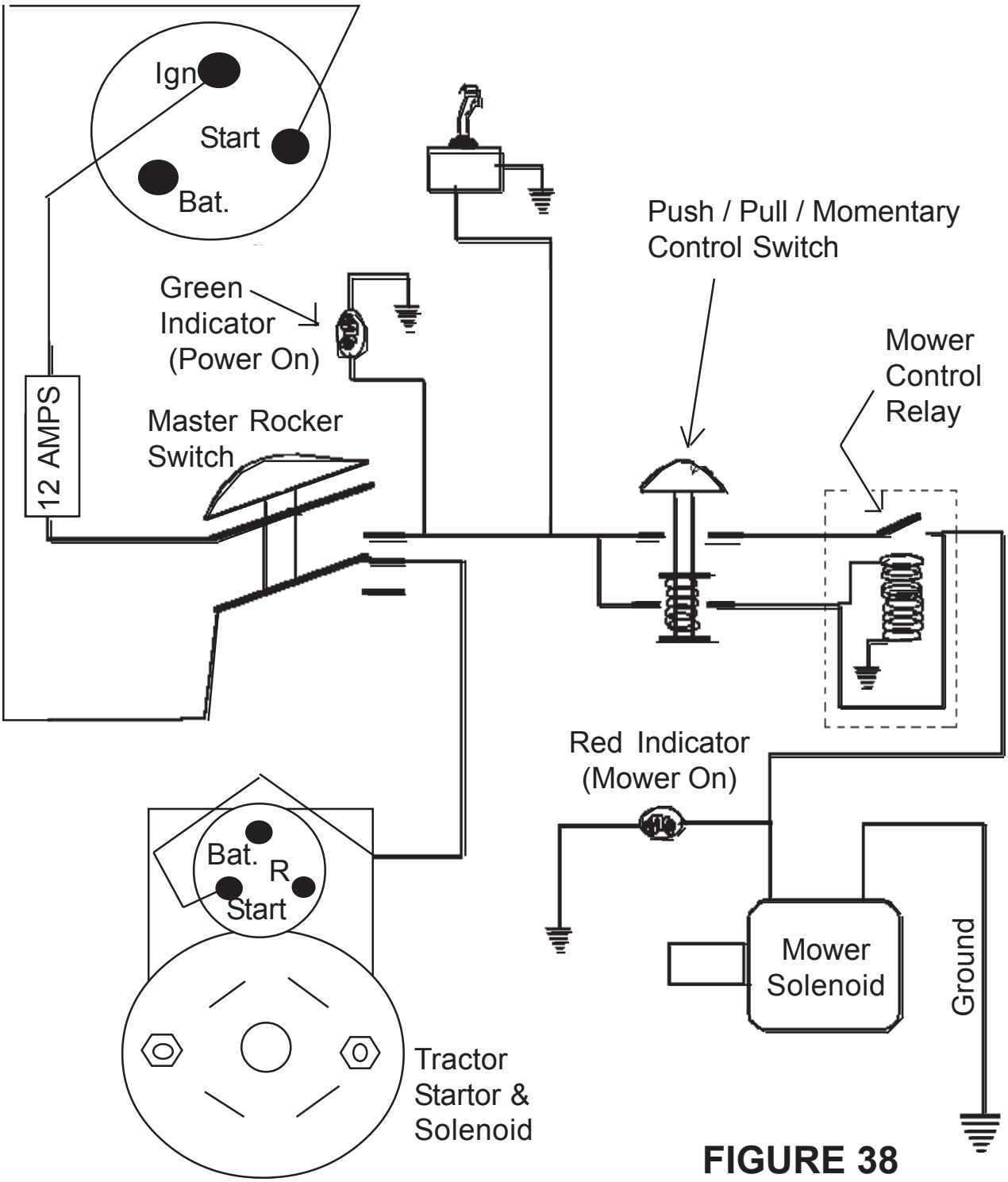

FIGURE 38

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MOTOR - ELECTRICAL CONTROL

Note: The Servo Control Valve, Lever and Solenoid have been replaced a manifold and Solenoid valve Cartridge, Please make note on all diagrams and text.

The Method used on the Machete to transmit Engine Power to the Mowing Head is called a “Closed Loop” or “ Hydrostatic” System (Figure 39). Engine Power is converted to Hydraulic Power by the Variable Displacement Hydraulic Piston Pump. Oil is sent to the Fixed Displacement Motor through the Hoses that run down the Boom. Oil passing through the Motor converts the Hydraulic Power Back into Mechanical Power to Rotate the Blades.

The Shuttle Valve in the Motor returns 8 GPM back to the Tank for Cooling. The remainder of the return oil remains in the Closed Loop. Some of the advantages of using a Closed Loop System for the Motor Circuit are 1. A Smaller quantity of Oil is required, 2. System acts as its own “Brake” slowing down the Blades and 3. Less Fuel consumed due to “No Load” condition when Motor Circuit is disengaged.

Another feature of the Alamo System is that the Oil is filtered after it leaves the Charge Pump and before it enters the High Pressure Loop.

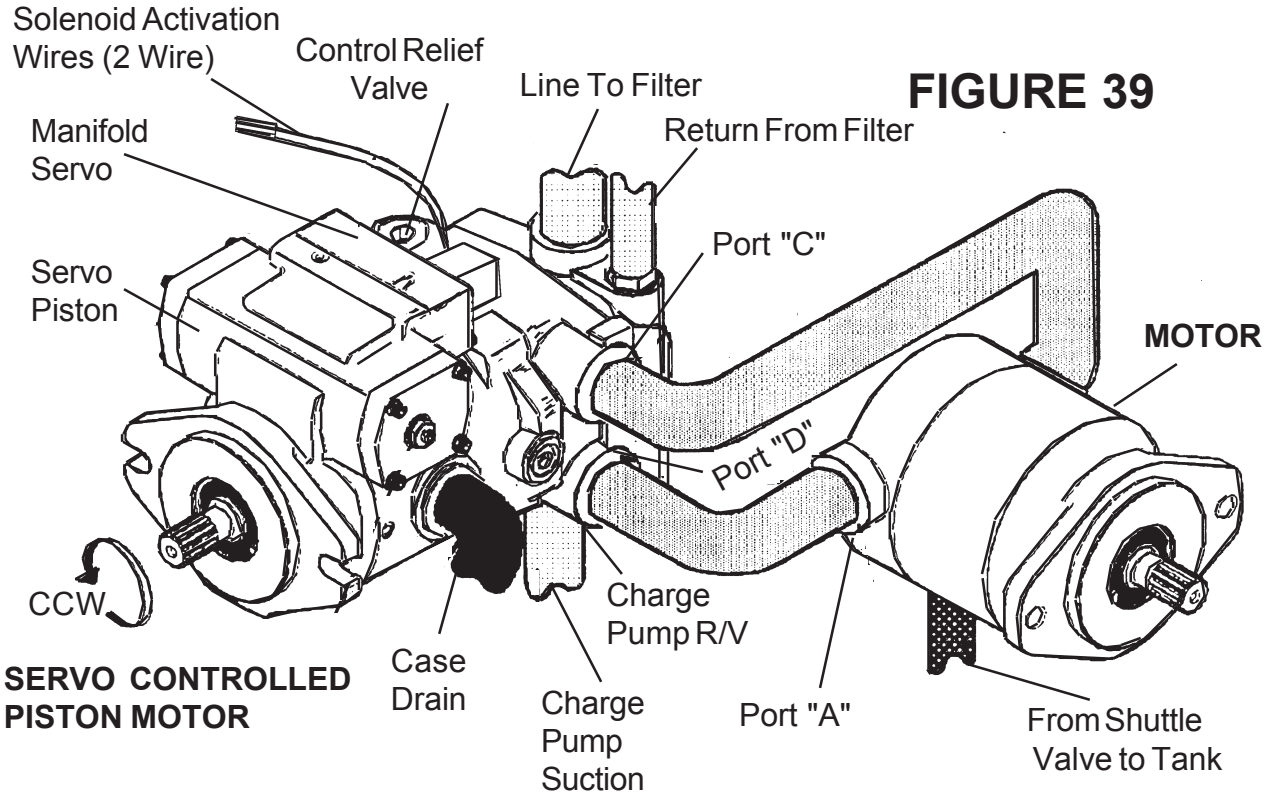

FIGURE 39

SERVO CONTROLLED PISTON MOTOR

The Motor Circuit is engaged by two Manually Operated Switches (See Figures 36, 37, & 38 for Types Used). These Switches have varied from “On - Off” to “Momentary’, But all have served the same purpose. Closing the Switches completes a Circuit through the Solenoid. The Purpose is for a “Solenoid” to actuate a Pump Control, which actuates a Valve to turn on Pump; this has varied some over the years. This movement causes the Camplate in the Pump to move. Movement of the Camplate when the Pump is turning causes the length of Piston Stroke to Change, Causing Oil to too be moved. The Greater the Angle, the longer the stroke, The longer the stroke the more Oil is Pumped, and the more oil pumped means faster the motor turns.

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MOTOR - PUMP ACTIONS

Note: The Servo Control System, (Changed see "Note" on Previous Page)

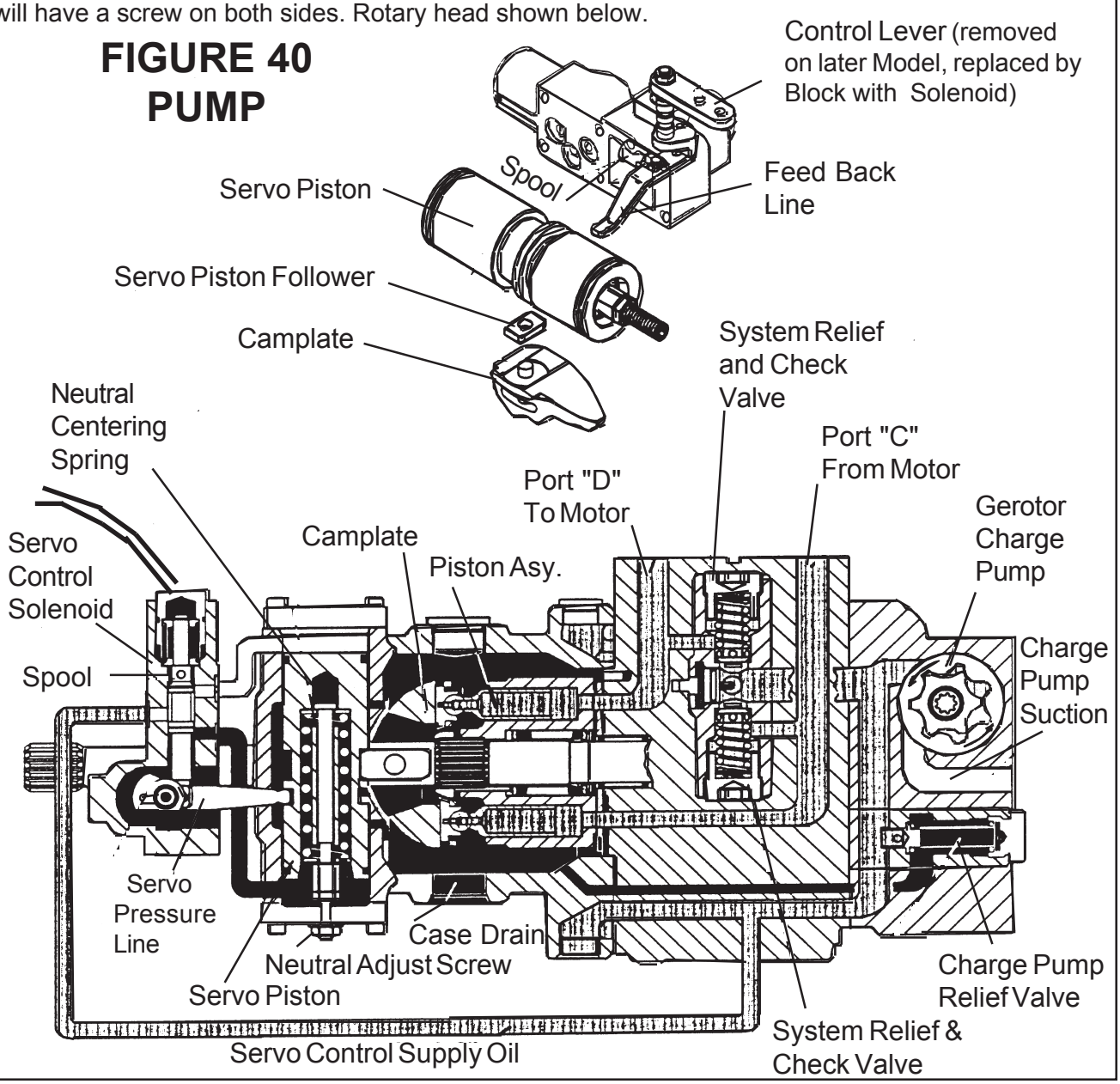
Pump Output is started by movement of the Variable Displacement Pump Control Lever (Figure 40). As the Lever is rotated, it moves the Spring centered Servo Control Spool first. Movement of the Spool allows Charge Pump Oil past the Spool to one side of the Servo Piston (Figure 40). The Pressurized Servo Piston pushed against the
Camplate (figure 40) causing the Camplate to rotate to a Pre-Set Angle. Oil from the opposite end of the Servo Piston is exhausted to the Pump Housing through the Control Valve Spool.

When the Control Lever (Solenoid & Block on Current Models) is returned to the Neutral position, The Spool centers itself, allowing the Pressure on both ends of the Servo Piston to equalize. The Piston and. Camplate return to a Neutral position and Oil flow from the Piston Pump ceases.

Speed of the Camplate movement is controlled by orifices between the Control Valve and the Servo Piston.

Neutral Adjustment Screw is to set Servo in Neutral position to prevent flow to motor, a Buzz Bar Head will have a screw on both sides. Rotary head shown below.

FIGURE 40
PUMP



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MOTOR - PUMP DIS-ENGAGE

Motor Circuit Disengage (w/ Engine Running)

The Alamo Closed Loop Motor Circuit is considered to be Neutral when there is no output being generated by the Variable Displacement Pump, as the Shaft, Internal components and Charge Pump are being driven by Tractor Engine. The Camplate is in the centered position and the length of Stroke of the Pistons is equal, therefore there is no flow being generated by the pump

At this point the Charge Pump is drawing Oil through a Suction Screen from the Tank to provide flow to perform the following functions.

1. Keep the Circuit Primed and make up internal leakage.
2. Maintain Back Pressure on Pump and Motor Pistons
3. Operate Control Functions to Start Pump.
4. Maintain Temperature Control, to prevent Oil Heating in Pump.

Oil from the Charge Pump is directed to two dual purpose system Relief and Check Valves (Figure 41). Since the Charge Pressure is greater than the pressure in either side of the Closed Loop, The Check Valves open and charged Oil (at Charge Pressure) is available to both sides of the closed Loop. When the System is primed, any excess Oil is relieved through the Charge Pump relief Valve, which maintains a pressure of 250 to 300 PSI.

The Piston Pump remains in Neutral as long as the Campmate remains in the centered position, this is controlled by the Servo Control System, If Pump does not stay in neutral check the Neutral Adjusting screw. This is usually noticed by Motor wanting to run.

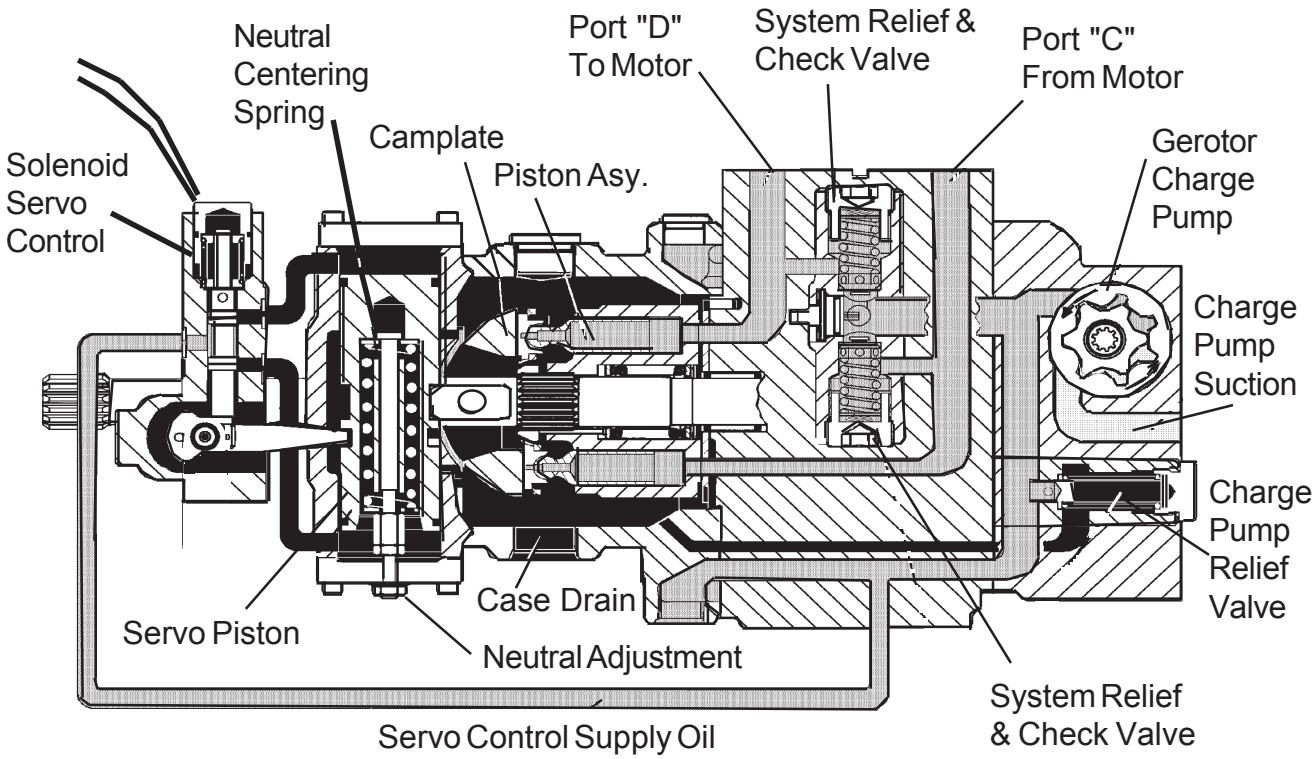

FIGURE 41 PUMP

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MOTOR - PUMP ENGAGE

Motor Circuit Engaged (w/ Engine Running)

When the Switch and Solenoid are activated, The Servo control System moves the Camplate to its Maximum Angle. As the Piston Block rotates, The Angle of the Camplate causes the Pistons to move in and out of their Bores as they follow the Camplate, This results in Oil being drawn into the Piston Bore as the Piston is pulled outward. The Oil being expelled into the other side of the Loop as the Piston is forced back into its bore, This creates the flow of Oil necessary to power the Motor. Movement of the Camplate angle from the neutral to maximum is set at approximately 6 seconds and is controlled by the size of the Orifice between the Control valve & Pump Case.

Oil under charge pressure is available at the Check Seats of the combination System Relief & Check Valves. As the Piston is drawn outwards in its bore, The combination of lower pressure in the Piston Bore and charge pressure in Port “C” causes the Check Valve for Port “C” to come off its seat, Allowing Oil At Charge pressure to fill the Piston Bore. As the Piston Block rotates the Oil is trapped in its bore by the Valve Plate. As the Piston Block rotates more, the piston is forced back into its bore expelling the Oil into Port “D” through an opening in the Valve Plate. The Higher pressure in Port “D” seats the Check Valve for Port “D”, Separating Oil in Port “C” from Oil in Port “D”. Oil is forced to go through the Motor causing Motor Rotation.

Any Leakage from the Piston Block Valve Plate, Pistons, or excess Oil from the Charge Pump Relief Valve is vented to the case and is returned to Tank through the case Drain Port.

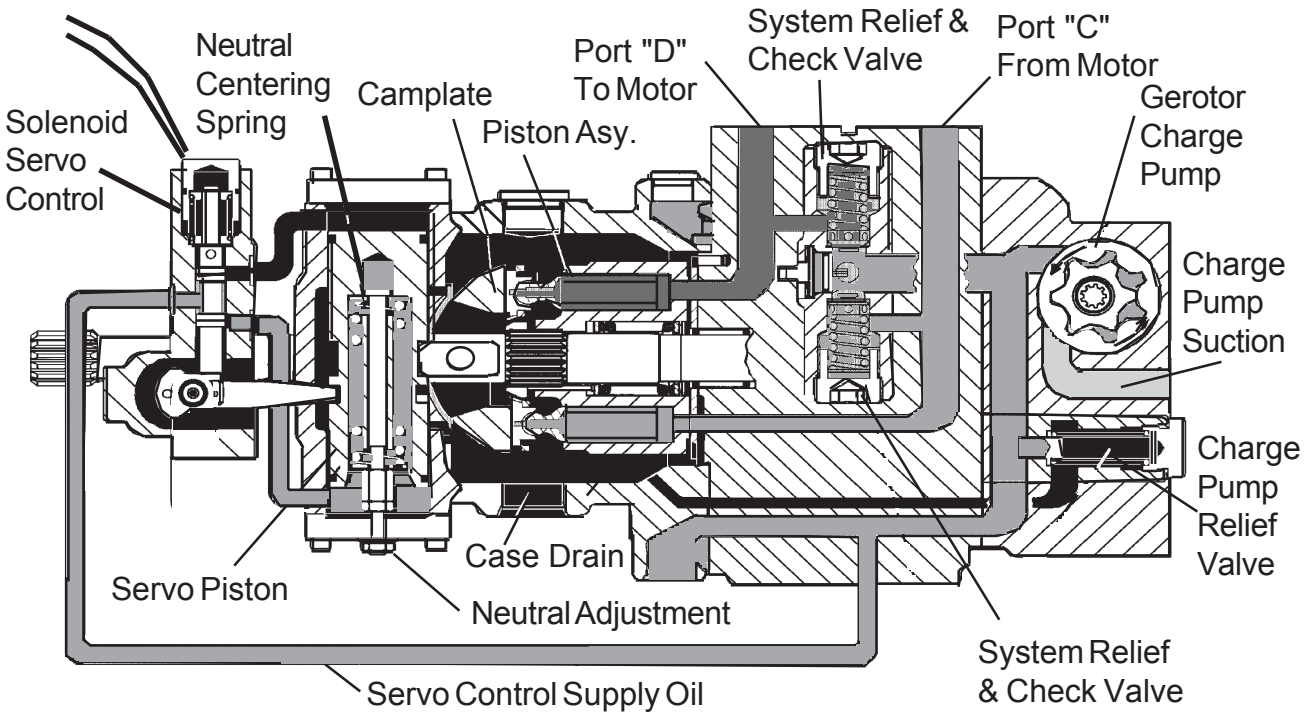

FIGURE 42 PUMP

Relief Valve Operation:

When the pressure in Port “D” exceeds the setting of the Relief Valve (4500 PSI), the large Spring in the Relief Valve is compressed, Opening an Orifice allowing excess Oil to relieve into the Charge Circuit, Since the Check Valve for Port “C” is open, The Oil is available to the intake side of Pump

There is also a relief Valve in the High Pressure side of the Loop at the Motor. This Valve is set to relieve at 4000 PSI and is in the circuit to absorb spike pressure encountered during severe operation.

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MOTOR - SYSTEM SCHEMATIC

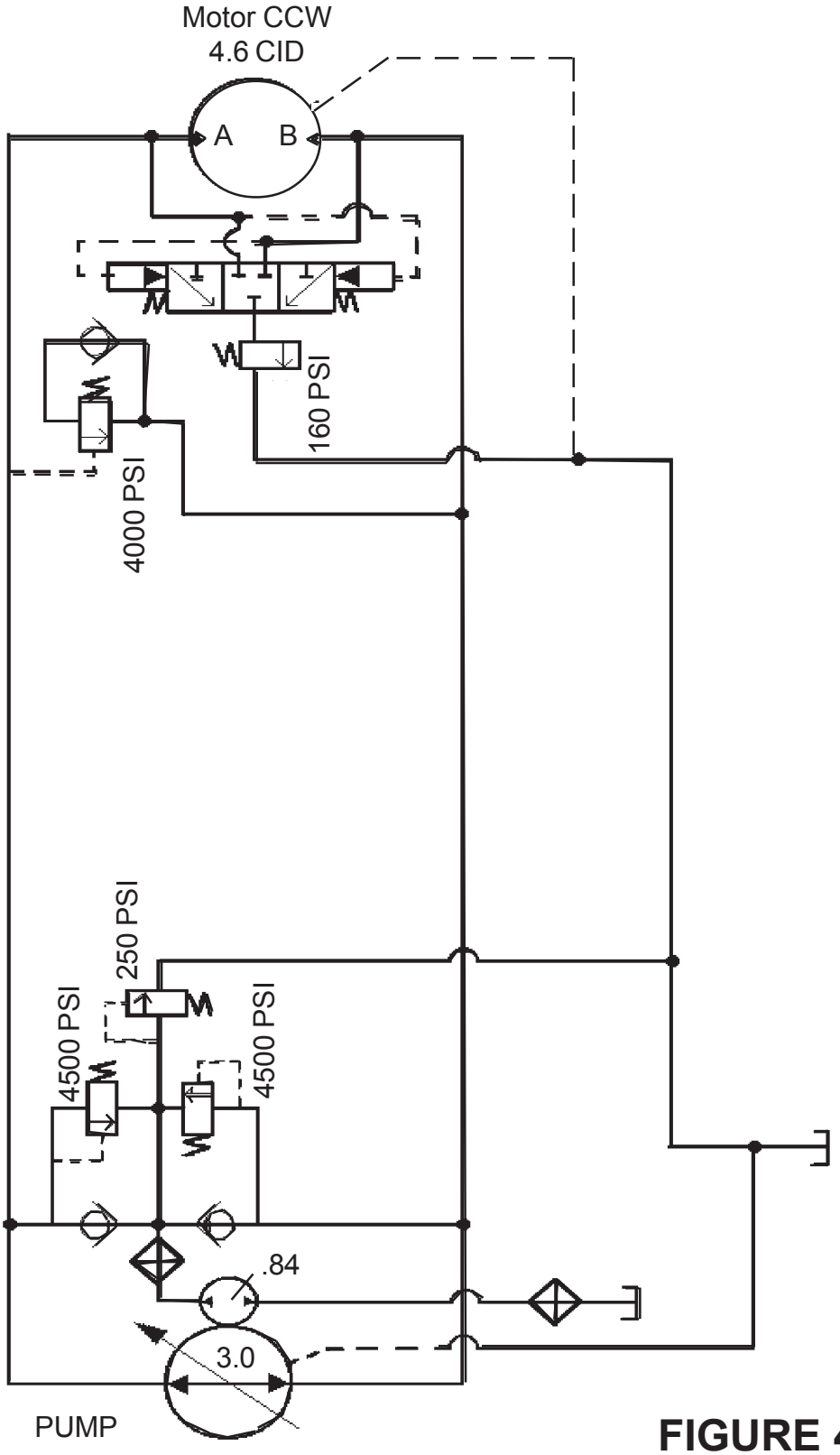

FIGURE 43

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MOTOR - SHUTTLE VALVE

Motor Shuttle Valve: (Figure 44 & 45)

The Shuttle Valve is located in the Motor Housing, The purpose of the Shuttle valve is to direct a controlled amount of Oil out of the Hydrostatic Loop and back to the Tank for Cooling

The Spool (item 3) is centered in its bore by springs on each end. While the Pump Shaft is turning and the Camplate is in the neutral Position (Figure 44), Both ends of the Shuttle Spool are exposed to a charge pressure. When the Camplate Angle is changed, The Pressured side if the Spool sees an increased pressure while the opposite end is still seeing the charge pressure (return side of circuit) (Figure 45). This causes the Spool to shift in its bore, opening a passage for Oil in the return side of the Loop to go to the Tank through the Case Drain Line.

The Volume of Oil flowing through the Case drain Line should not exceed the Charge Pump Volume unless excessive internal leakage exists in the Motor. The low Pressure relief is designed to prevent the Motor seal from blowing out if excessive pressure should enter case.

The Case Drain serves to lubricate the Motor, approx. 3 GPM goes through to Lube motor. The volume through case drain should not exceed 8 GPM, if it does check the motor for wear or a malfunction.

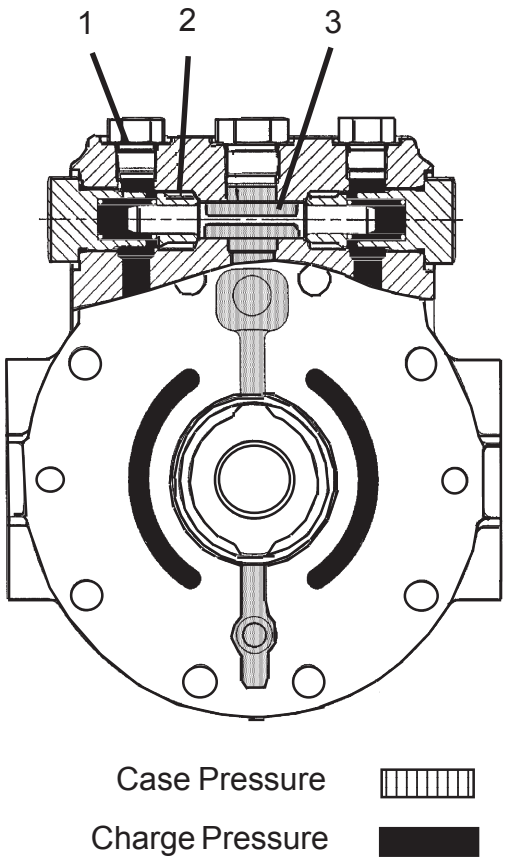

FIGURE 44

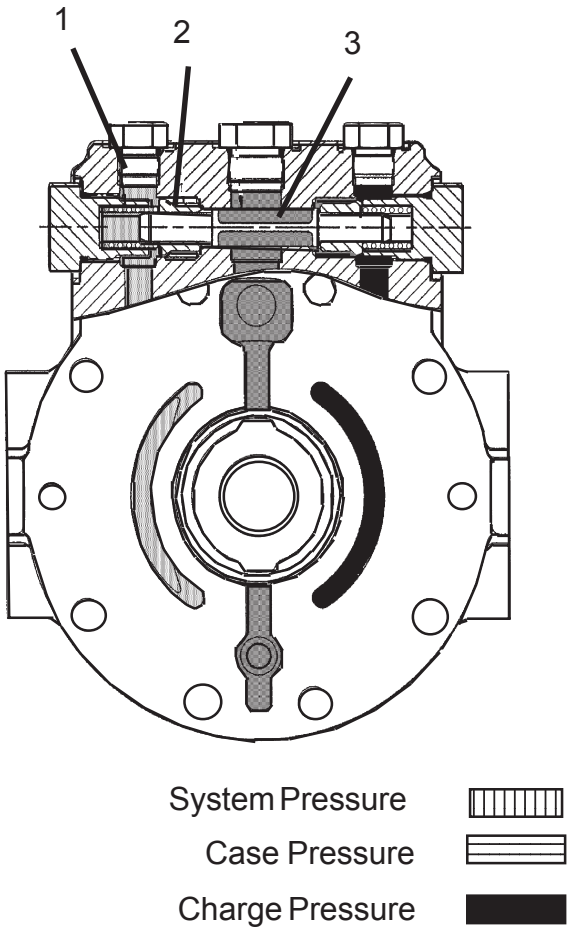

FIGURE 45

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Motor Dis-Assembly or Assembly Comments:

The purpose of this Section is to provide Service information and procedures for Dis-Assembly and Re-Assembly of the Hydrostatic Fixed Displacement Motors. Motors with Valve Blocks, Motors with integral Shuttle and Low Pressure Relief Valves are covered. The Procedures in this Manual will allow better Service of Motors. This Manual will show some Components Dis-Assembled that are not available as replacement parts, Some Sub-Assemblies that are to be Dis-Assembled for cleaning or inspection only. There are Special Tools that may be required. SEE BACK PAGES for Tool Drawings.

Tools Required: Recommended Tools for Service / Repair Work on Motor

1. Stationary Seal Puller (1/4" X 20 UNC Cap Screw, 3" to 4" Long)
2. Rotating Seal Puller, (Special Tool)
3. Retaining Ring Pliers, (No. 5 and No.7)
4. Ratchet Wrench or Breaker Bar (Drive Size Optional)
5. Wrench, Box End / Open End Combination, (1-3/8")
6. Wrench, Box End / Open End Combination, (1")
7. Socket, (Drive Size Optional)
8. Torque Wrench, (200 ft. lb. Capacity Drive Size Optional)
9. Hex Bit Socket, (1/4")
10. Hex Key, (1/4")
11. Tube Locktite (No. 271)
12. Pliers
13. Punch
14. Magnetic Base Indicator Dial
15. Hammer
16. Bearing Press or Driver
17. Light Petroleum Jelly (Like Vaseline)
18. Cleaning Solvent (CLEAN UN-USED NON-CONTAMINATED), Non-Petroleum Base
19. Two Headless Cap Screws, (5/16" X 5" to 6" Long) Special
20. Micrometer or Vernier Calipers
21. Small Screwdriver, (1/8" Blade)
22. Low Clearance Bearing Puller, (Special)
23. Filtered Moisture Free Compressed Air / Clean Lint Free Rags (IF NOT LINT FREE, DO NOT USE THEM)

GENERAL NOTES:

1. DO NOT Dis-Assemble anything till everything has been thoroughly cleaned on or around Motor, Connections and Head.
2. Seal All Opening to Hydraulic System when opened to keep Contamination Out, This will include opening in all Fittings, Hoses and Motor.
3. Whenever a Unit is dis-assembled and cleaned lubricate Parts with Clean Lubricant as soon as possible to keep moisture off of them.
4. Always use New Seal to Re-Assemble and lubricate them with Petroleum Jelly (Vaseline).
5. Cleanliness is extremely important when repairing ANY HYDRAULIC Components. The Work Area, Tools and anything that comes in contact with components. Always clean parts in clean Solvent and Blow Dry with filtered moisture free Air is best.

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MOTOR P/N 02967193

Parts Location & Assembly Instructions

This Section is for Motor Asy P/N 02967193
Used on 60 inch Rotary Head

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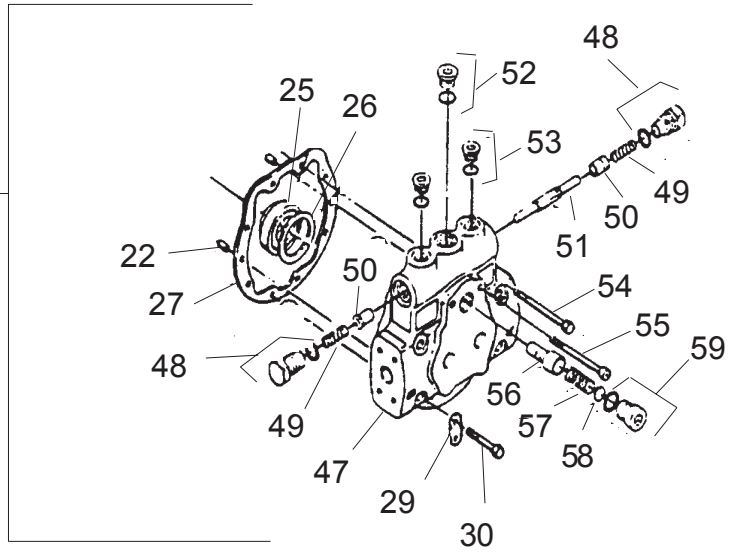
MOTOR P/N 02967193 - PARTS LOCATION

End Cover with Integral Shuttle and Low Pressure Relief Valve (Used on Machete Motor)



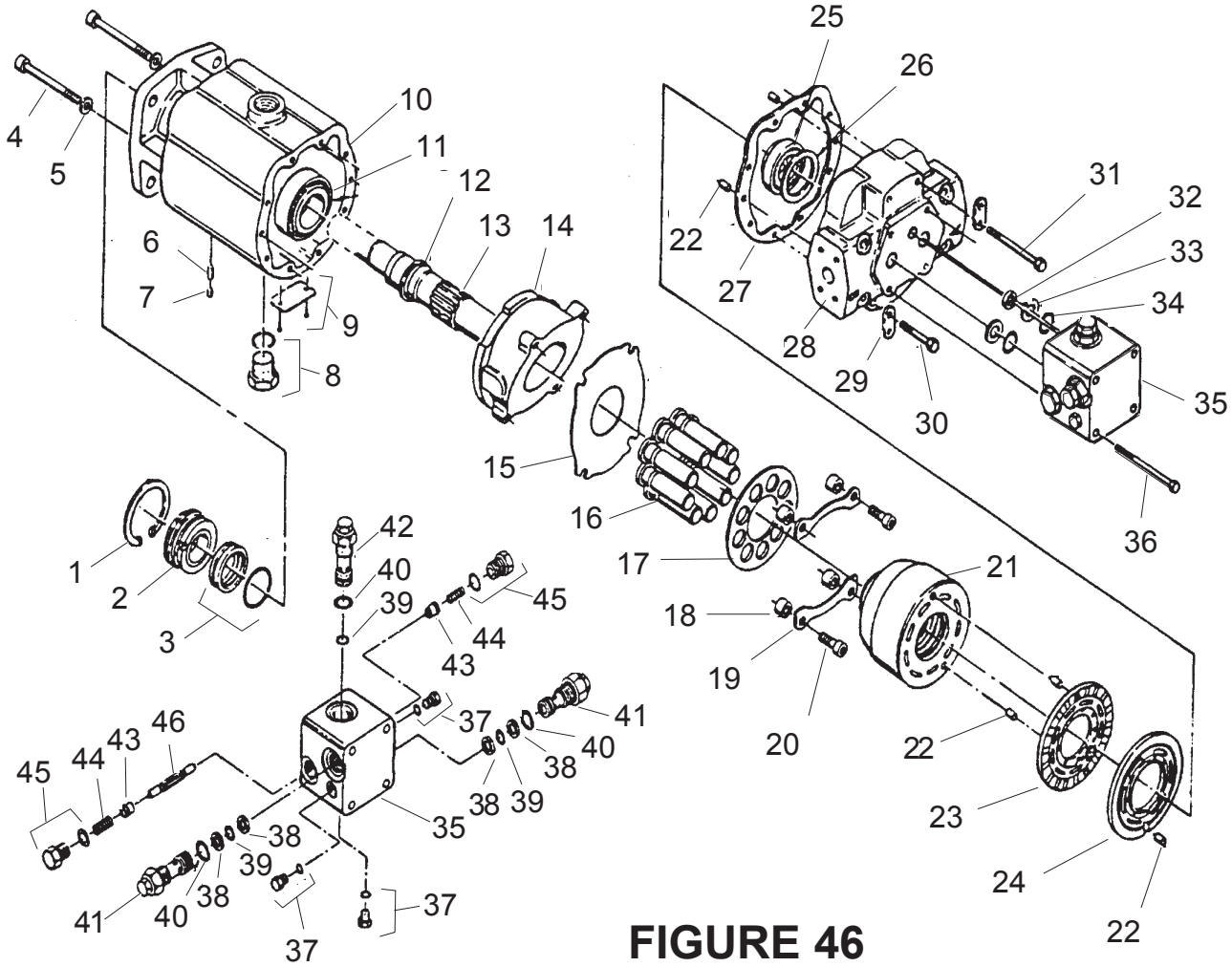


FIGURE 46

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MOTOR P/N 02967193 - PARTS LOCATION

Motor Assembly P/N 02967193

Item	Qty	Description
1.	1	Retaining Ring
2.	1	Stationary Seal
3.	2	Rotating Seal & O-Ring
4.	2	Cap Screw
5.	1	Washer
6.	1	Dowel Pin
7.	1	Plug, Pipe (Socket Head)
8.	1	Case Drain Plug & O-ring
9.	1	ID Tag & Screws
10.	1	Motor Housing
11.	1	Output Shaft Brg. (Cup & Cone)
12.	1	Retaining Pin
13.	1	Motor Drive Shaft
14.	1	Swash Plate
15.	1	Thrust Plate
16.	9	Piston & Slipper Asy.
17.	1	Slipper Retainer Plate
18.	4	Spacer
19.	2	Retaining Strap
20.	4	Cap Screw
21.	1	Cylinder Barrel Asy.
22.	5	Dowel Pin (5/16" X 5/8" Long)
23.	1	Bearing Plate
24.	1	Valve Plate
25.	1	Brg, End Cover (Cup & Cone)
26.	var.	Shim (End Cover Brg Shims)
27.	1	Gasket (End Cover)
28.	1	End Cover (Standard Motor)
29.	2	Lifting Strap
30.	2	Hex Head Bolt
31.	6	Hex Head Bolt
32.	1	Square Cut seal
33.	2	Back-Up Washer
34.	2	O-Ring
35.	1	Valve Block Asy.
36.	4	Hex Head Bolt
37.	3	Gauge Port Plug & O-Ring
38.	4	Back-Up Ring
39.	3	O-Ring
40.	3	O-Ring
41.	2	Relief Cartridge, Hi-Pressure
42.	1	Relief Cartridge, Lo-Pressure
43.	2	Shuttle Valve
44.	2	Shuttle Spring
45.	2	Shuttle Valve Plug & O-Ring
46.	1	Shuttle Spool
47.	1	End Cover w/ Integral Shuttle & Lo-Pressure Relief valve.
48.	2	Shuttle Valve Plug & O-Ring
49.	2	Shuttle Spring
50.	2	Shuttle Valve
51.	1	Shuttle Spool
52.	1	Gauge Port Plug & O-Ring
53.	2	Gauge Port Plug & O-Ring
54.	4	Bolt, Hex Head
55.	2	Bolt, Socket Head
56.	1	Plunger
57.	1	Spring
58.	var.	Shim, Lo-Pressure Relief Valve
59.	1	Lo-Pressure Relief Valve Plug & O-ring

Var. - Shims Vary in Qty, Use as required, Item # 28 & # 47 used one or the other not both.

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MOTOR VALVE BLOCK - DIS-ASSEMBLY

VALVE BLOCK / INTEGRAL SHUTTLE REMOVAL:

1. Position the Motor on its mounting Flange as shown in Figure 48. If the Motor has a Integral Shuttle and Low-Pressure Relief see Figure 49, Valve Block see Figure 48 loosen all of the Relief Valve Plugs in the Valve Block. Keep track of how many Shims are removed with each Relief Plug. Remove the four bolts that hold the Integral Shuttle valve or Valve Block to the Motor, Remove the Integral shuttle Valve or Valve Block (See Figure 48 or 49)

2. Removes O-Rings and Back-Up Rings f/ the Motor that is under Valve Block on top of Motor.

3. On Motor with Valve Block (Figure 48) use 1-3/8" Wrench to remove Valve Block Low Pressure and High Pressure Relief Valve Cartridge, The Low Pressure Relief will not have white Back-Up Rings only O-Ring in lower groove. High Pressure Relief Valves will have two white Back-Up Rings and one O-Ring in lower groove, This will help to ID Pressure Relief Valves. Low & High Pressure Relief Settings are Pre-Set at factory, The Stampings of three digit codes on Cartridge identifies setting. 1 St. Digit = 1000 Th., 2 Nd. digit = 100 Th. and 3 rd digit = 10 Th. (example Low Pressure Codes # 061 code = 160 PSI (11 Bar), 022 = 220 PSI (15 Bar), or High Pressure Codes # 500 = 5000 PSI (344 Bar), 400 = 4000 PSI (275 Bar).

On Motor with Integral Shuttle Valve (Figure 49), Unscrew Low Pressure Relief Valve, Note the Shims as you dis-assemble Low-Pressure Relief, Count Shims, as this is how many should be re-installed during re-assembly.

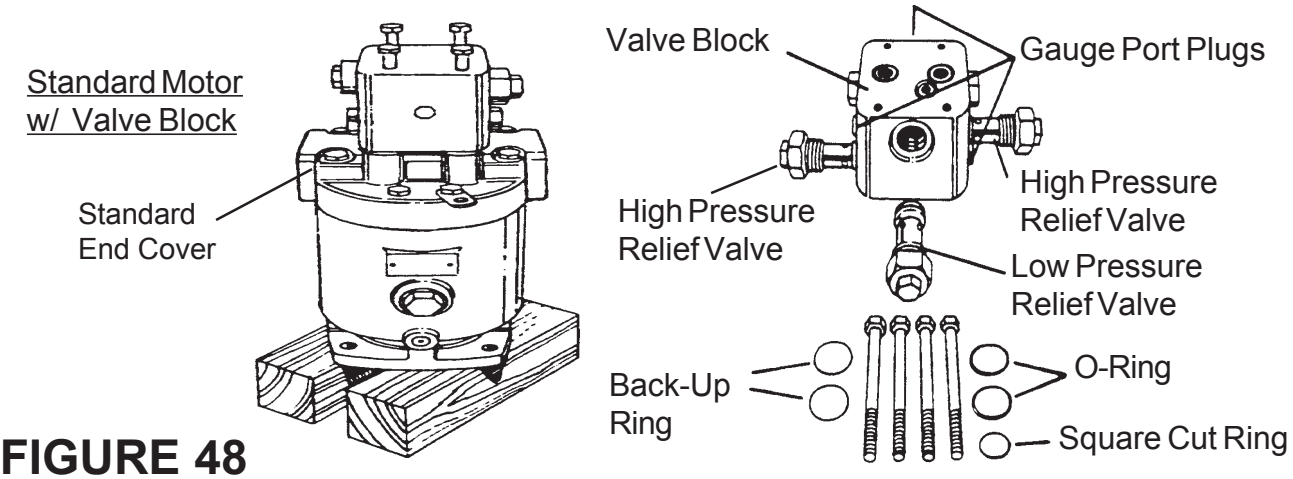

FIGURE 48

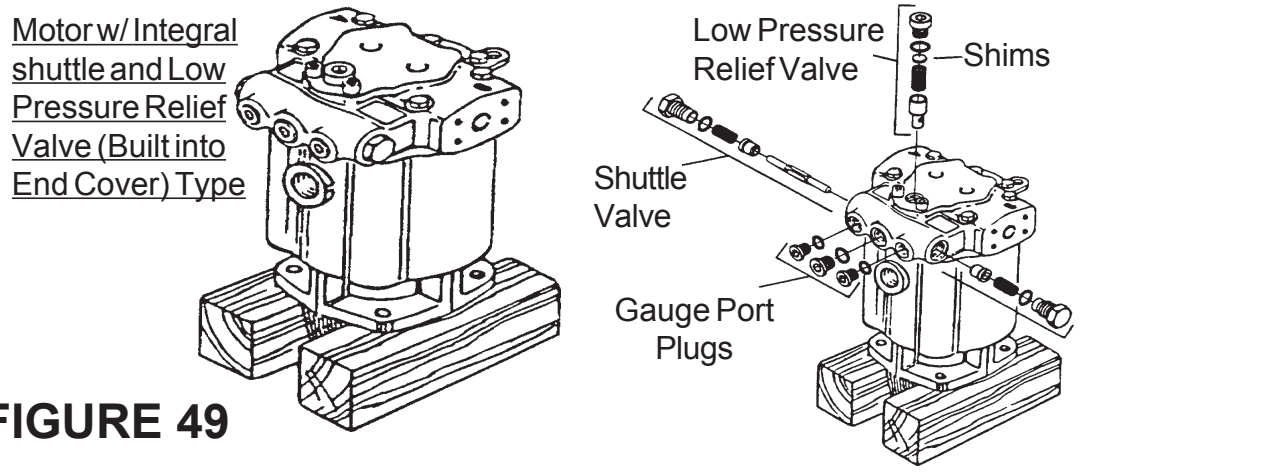
Motor w/ Integral shuttle and Low Pressure Relief Valve (Built into End Cover) Type
Low Pressure Relief Valve
Shims
Shuttle Valve
Gauge Port Plugs

FIGURE 49

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MOTOR VALVE BLOCK - DIS-ASSEMBLY

VALVE BLOCK DIS-ASSEMBLY: (On Standard Motor)

1. Use 1" Hex Wrench to remove Shuttle Valve Plugs, The remove Shuttle valve Plugs (Figure 50)
2. Remove Shuttle Valves and Shuttle Spools (Figure 50 & 51)
3. Remove Gage Port Plug Assemblies.

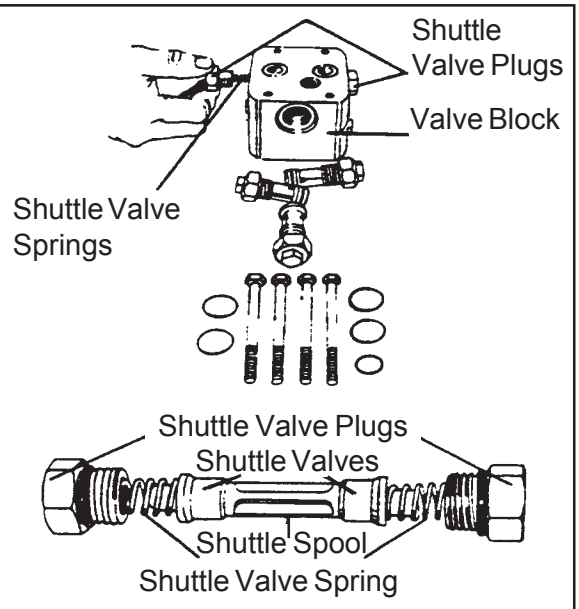

FIGURE 50

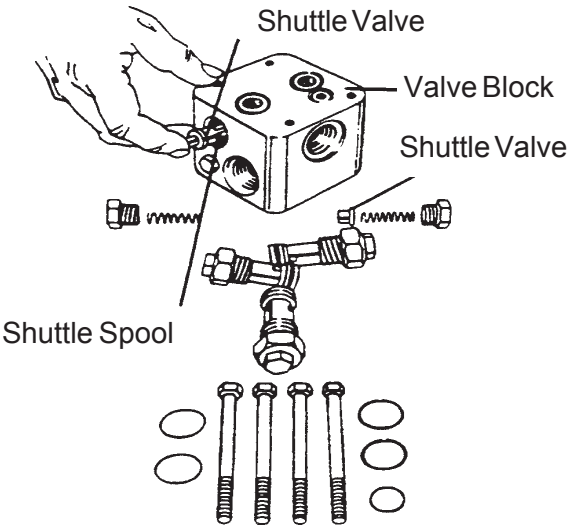

FIGURE 51

VALVE BLOCK RE-ASSEMBLY: (On Standard Motor)

1. Install 3 Gage port Plug Assemblies, Torque Plugs to 16 ft. lbs (22 nm) Figure 52
2. Install Shuttle Spool and Shuttle Valves in Valve Block. Figure 52
3. Install Shuttle valve Plugs and Shuttle Valve Springs. Torque to 68 ft. lbs. (92 nm) Figure 53

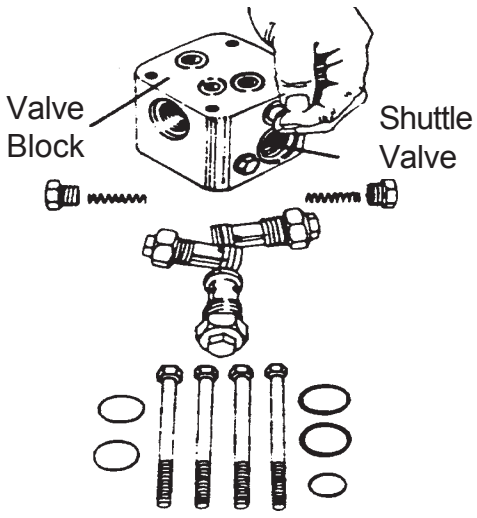

FIGURE 52

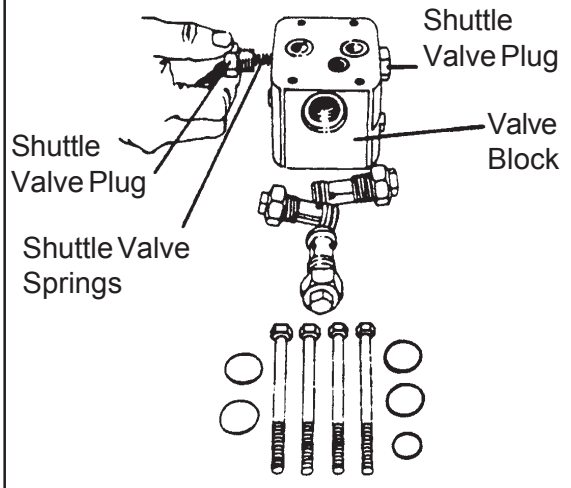

FIGURE 53

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MOTOR VALVE BLOCK - REASSEMBLY

4. Install 2 High Pressure Relief Valves as Shown in Figure 54, Torque to 25 ft. lbs. (34 nm)
5. Install Low Pressure Relief Valve as Shown in Figure 55, Torque to 75 ft. lbs. (100 nm).
6. Install Valve Block back on Motor if this all that was being repaired or set it aside for now if more work is being done on motor.

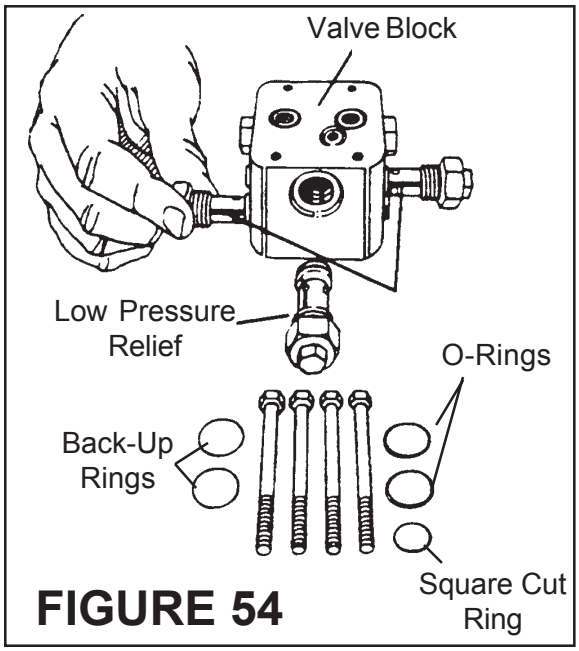

FIGURE 54

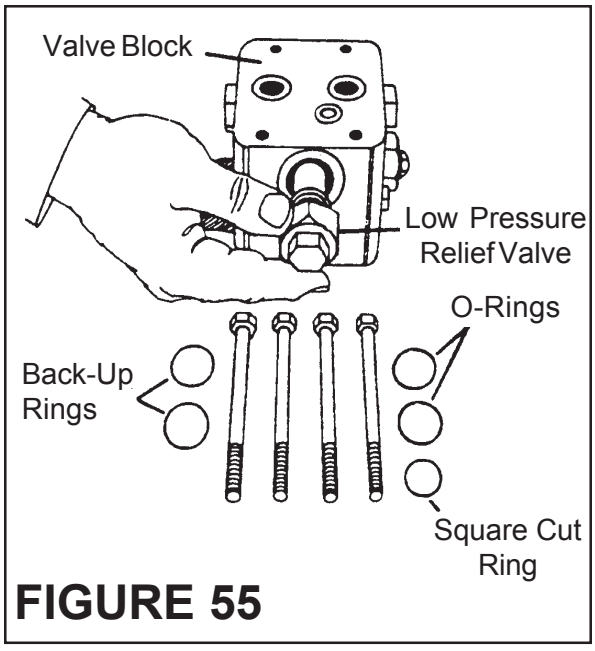

FIGURE 55

INTEGRAL SHUTTLE / LOW PRESSURE RELIEF VALVE (END COVER) RE-ASSEMBLY:
(On Machete Motor) See Figure 56

1. Install Low Pressure Relief Valve Make sure to install the same amount of Shims back into Relief Valve as was removed.
2. Install Shuttle Valves in End Cover
3. Install Gauge Port Plugs
4. DO NOT TIGHTEN ANY of these components at this time unless this is all that is being repair, If so go to Figures 75 and 76 later in this Manual for Torque Settings and more detailed Assembly instructions.
5. See Previous Page Figure 44, 45 and 49 on Dis-Assembly more details on the End Cover.

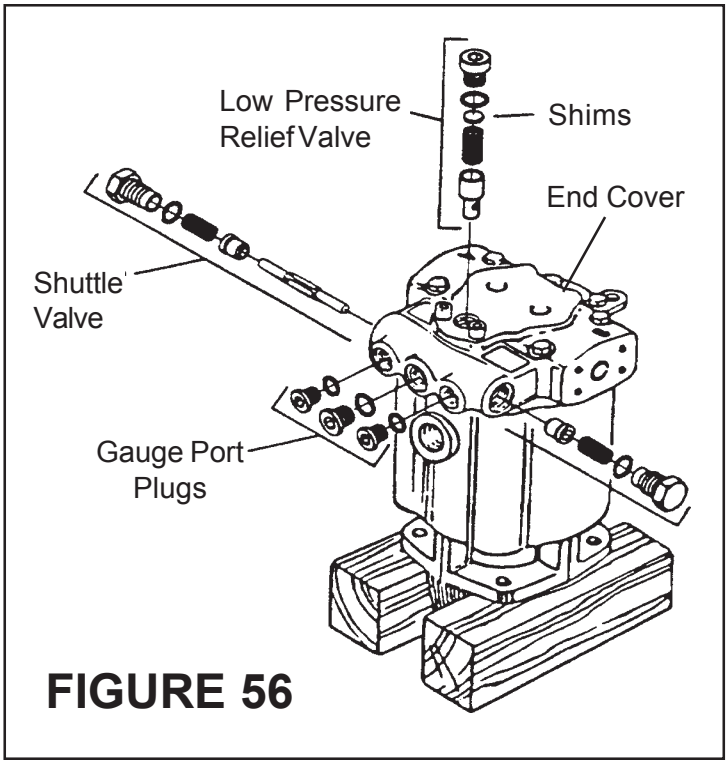

FIGURE 56

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MOTOR P/N 02967193 - DISASSEMBLY

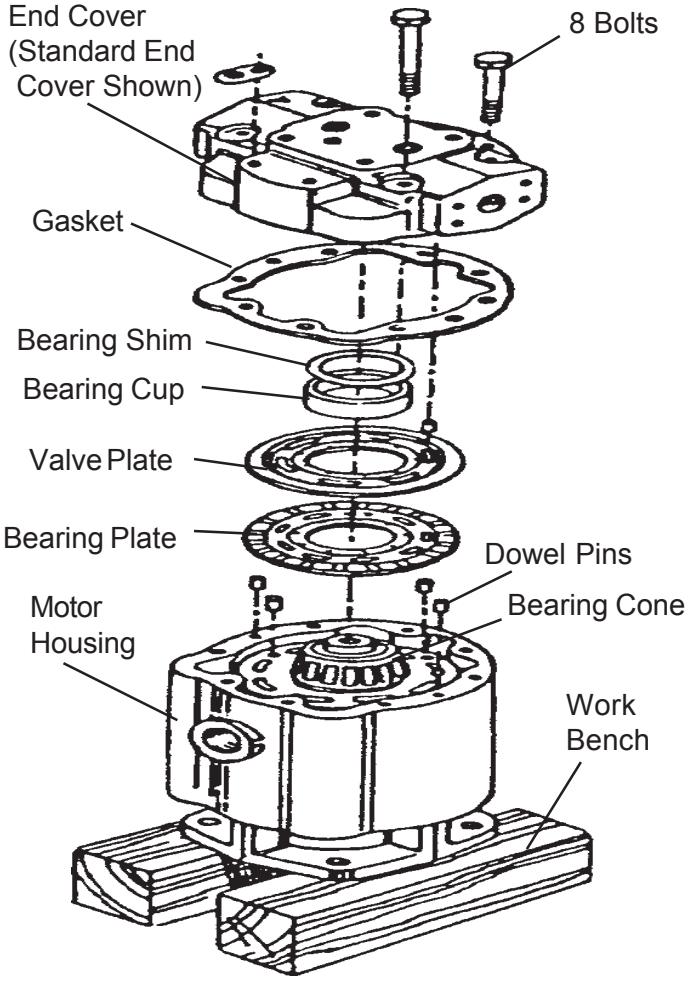

FIGURE 57

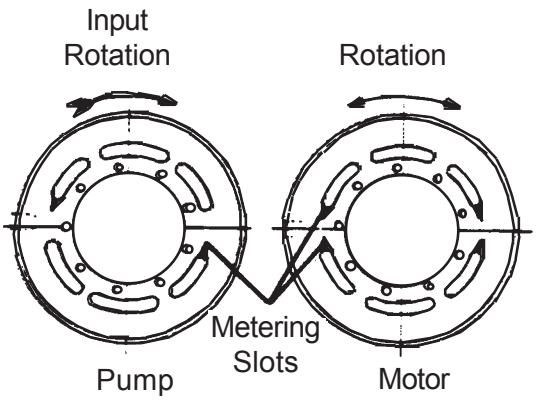

FIGURE 58

VALVE PLATES: Helpful Hint!

Shown above (Figure 58) is Pump and Motor Valve Plates for comparison, Pump Valve Plate (Left) has two Metering Slots and is Directional (Which is Clockwise). The Motor Valve Plate (Right) is bi-directional and has four Metering Slots, (Which allows for Clockwise or Counter Clockwise Rotation). Make sure correct Valve Plate is installed in Motor or Pump. HANDLE VALVE PLATES & BEARING PLATES with extreme care. Both Plates are lapped to extremely close tolerances for flatness.

END COVER DIS-ASSEMBLY: (Figure 57)
(On Standard Motor or Integral Shuttle & Low Pressure Relief Valve End Cover)

1. There are two different End Covers for this Motor, The Same procedure to remove the either the Standard End Cover or Integral Shuttle with Low Pressure Relief Valve End Cover from the Motor is the same. Check which one you have, See Figure 57 or Figure 56.
2. Remove 6 of the 8 Hex Bolts from End Cover (leave 1 tight at each end of cover), USE CAUTION, Internal Parts are Spring Loaded. To avoid internal Part Damage Slowly (Alternately) from one bolt to the other loosen the remaining 2 Bolts, Holding Pressure down on End Cover Slowly remove the other 2 bolts. KEEP PRESSURE on End Cover.
3. With pressure on End Cover start to release pressure and End Cover should start to rise, If it doesn't rise, Keep your hand on it and tap it with a hammer lightly to loosen it up from housing. Let End Cover rise till there is no Pressure pushing up. Remove End Cover.
4. Carefully remove Gasket and two End Cover Dowel Pins, DON'T drop any parts (See Valve Plate Above Comment), Valve Plate, Bearing Cup or Shims which May or May Not stick to End Cover.

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MOTOR P/N 02967193 - DISASSEMBLY

Motor Dis-Assembly:

GENERAL RULES:

1. DO NOT Dis-Assemble anything till everything has been thoroughly cleaned.
2. Cleanliness is extremely important when repairing ANY HYDRAULIC Components. The Work Area, Tools and anything that comes in contact with components. Always clean parts in clean Solvent and Blow Dry with filtered moisture free Air is best. (DO NOT SPIN BEARINGS WITH COMPRESSED AIR WHILE CLEANING)
3. All Torque specifications are for Clean (Good Un-Damaged) threads. Bolts for Gasketed Surfaces should be re-torqued a second time.
4. Replace All Seal with new ones whenever unit is dis-assembled; always lubricate Seals (except metal sealing surfaces of Shaft Seal Assembly) with Petroleum Jelly (Vaseline), Use only clean recommended Oil when Re Assembling Motor.

SHAFT SEAL REMOVAL: (See Figure 47)

1. Use a Pair of Retaining Ring Pliers to remove Retaining Ring (Figure 47).
2. Insert Stationary Seal Puller into threaded hole of Stationary Seal Assembly to pull Seal Assembly from Output Shaft (Figure 47).
3. Use Rotating Seal Puller (Owatonna Tool Company Tool No. CAS 1844) to grip outside diameter of Bronze Rotting Seal, Remove Seal from Output Shaft.
4. O-Ring may remain in Rotating Seal Recess, If O-Ring is not found in Recess, Remove O-Ring from main Motor Shaft. You don't want this O-Ring left un-accounted for as this could cause a problem during re-assembly later.

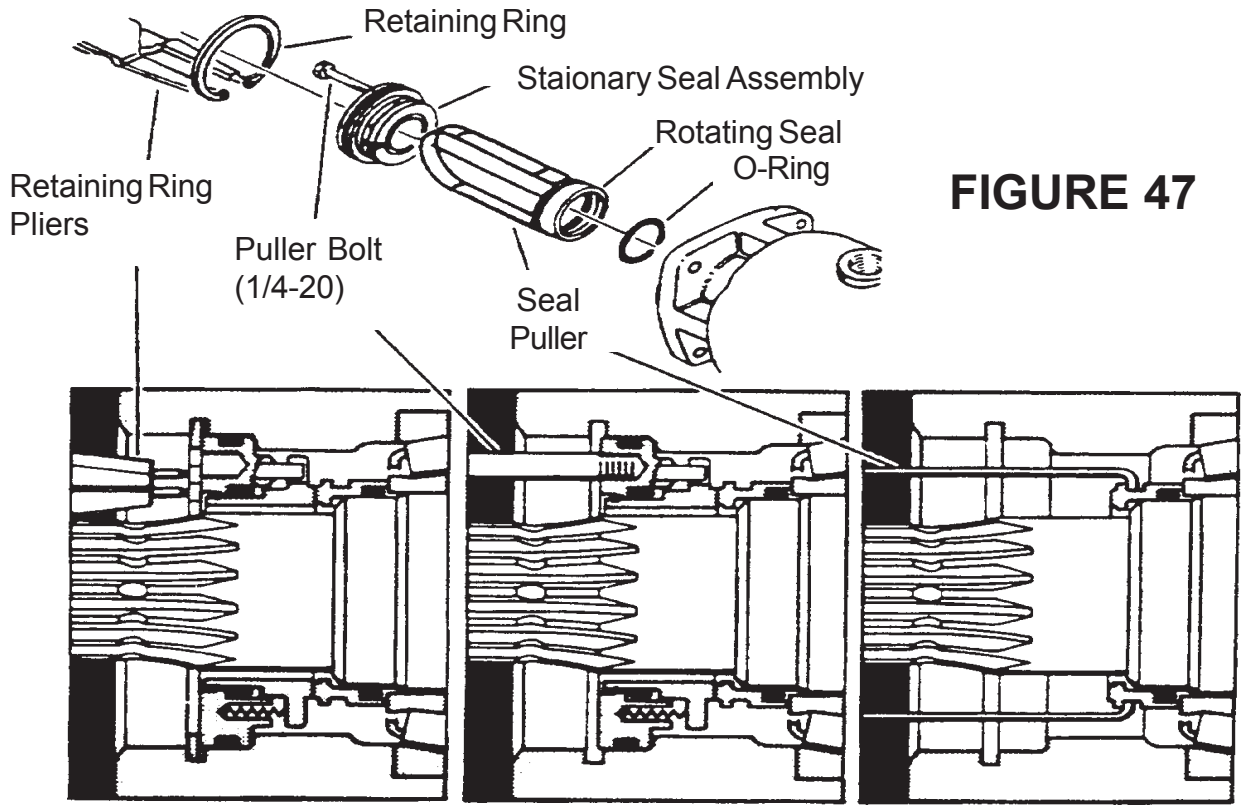

FIGURE 47

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MOTOR P/N 02967193 - DISASSEMBLY

BEARING CONE, OUTPUT SHAFT, CYLINDER BARREL & SWASH PLATE DIS-ASY:

1. Use of Low Clearance Bearing Puller is recommended for removal of end Cover Bearing Cone (Figure 59). The Bearing Puller pulls against Bearing Rollers, Not against Inner Race. It is designed to prevent Bearing Cone and Cylinder Barrel Face from being damaged, Close clearance between End Cover Bearing and Cylinder Barrel makes it difficult to use any other type Bearing Puller (See Recommended Tool List in previous pages of Motor Section for Bearing Puller information).
2. Use Lint free Cloth (or other Lint free Material) as a cover to prevent contamination from getting in while removing Bearing.
3. Install Bearing Puller and remove Bearing Cone from Output Shaft (Figure 59)

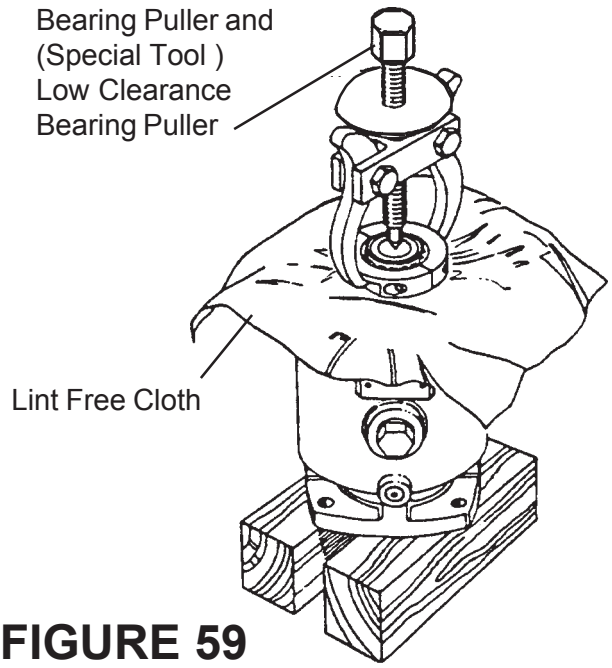

FIGURE 59

4. Carefully reposition Motor on its side (Figure 60). Using 1/4" Hex Bit Socket, Remove the two Cap Screws that retain Swash Plate in Housing. Remove and discard the Washers on these Cap Screws, DO NOT reuse them. Always use new Washers.
5. Push Output shaft Assembly inward to dislodge Swash Plate from its Pocket in Housing.
6. Carefully remove Cylinder Barrel Assembly in the Up position, Remove Output Shaft Assembly (Figure 61)
7. When Output Shaft Bearing Cone must be replaced, Use a Press to remove Cone from Shaft. You Must use Special Stop Limit Tool when installing new Bearing Cone on Output Shaft.

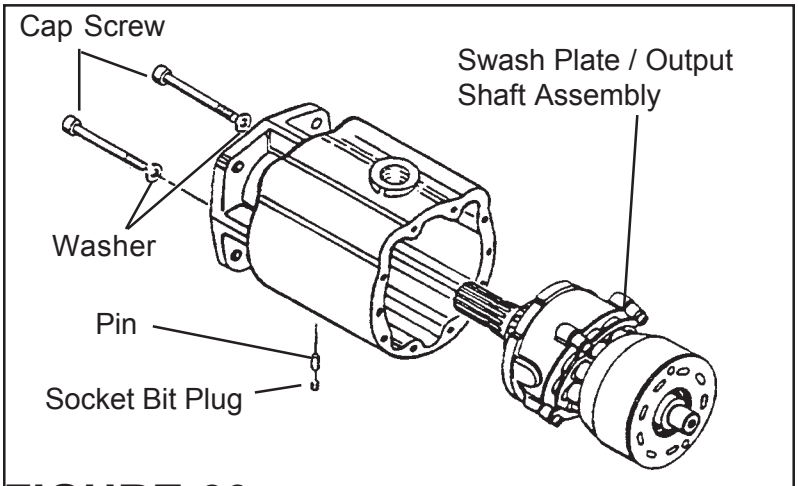

FIGURE 60

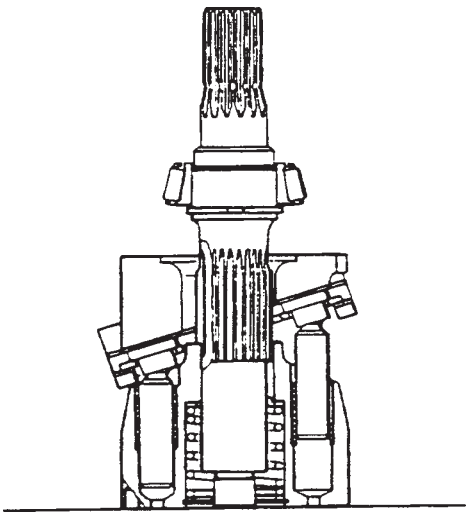

FIGURE 61

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MOTOR P/N 02967193 - DISASSEMBLY

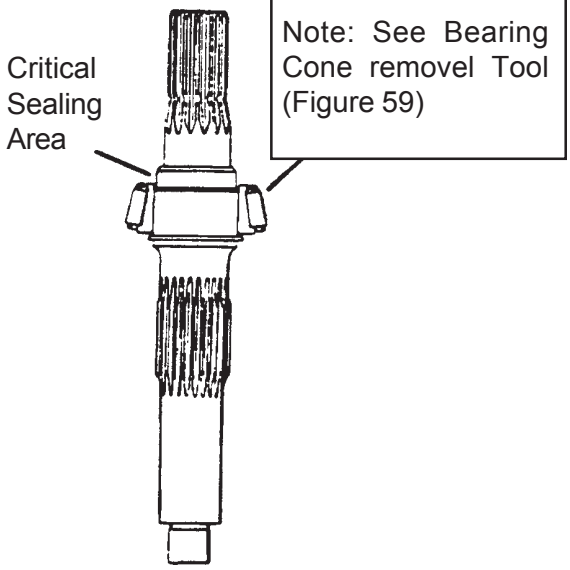

FIGURE 62

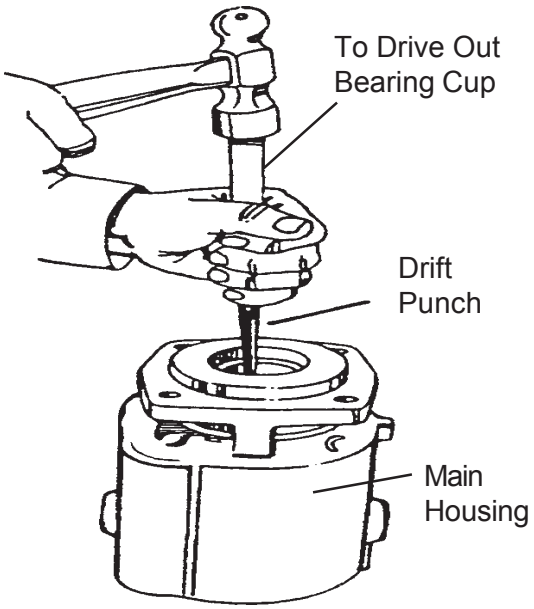

FIGURE 63

8. When removing or installing Bearing Cone, DO NOT damage Output Shaft Sealing area (Stepped area between Bearing Journal and Output Shaft Splines) This area is critical for sealing Output Shaft Seal (Figure 62).

9. Use suitable Bearing Puller or Punch to remove Bearing Cup from Main Housing (Figure 63)

10. Reposition Cylinder Barrel and Swash Plate so that Swash Plate is in down position. Use 1/4" Hex Key to remove Cap Screws from retaining straps on one side of Swash Plate. Loosen Cap Screws on other Retaining Strap; this will make it easier to remove Cylinder Barrel from Swash Plate (Figure 64)

11. Carefully reposition Cylinder Barrel and Swash plate in the Up position. Remove Swash Plate by lifting it slightly and sliding it over to dis-engage from retaining Strap.

12. Remove Cap Screws, retaining Strap, Spacers and Thrust Plate from Swash Plate (Figure 64).

13. Dis-Assemble Cylinder Barrel Assembly; Place it on a clean protective surface for inspection and cleaning.

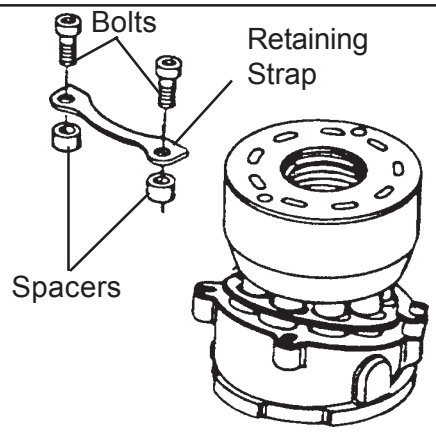

FIGURE 63

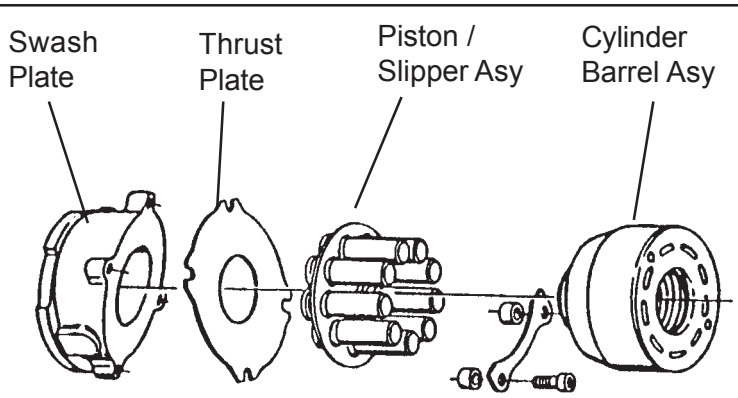

FIGURE 64

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MOTOR P/N 02967193 - ASSEMBLY

ROTATING GROUP RE-ASSEMBLY:

1. Before re-assembly of Fixed Displacement (Fixed Clearance) Motor, Clean all Parts and Assemblies in clean Solvent and Blow Dry with compressed Air. Inspect and Replace all Scratched or Damaged Parts. When Re-Working Parts DO NOT use Coarse Grit Paper, Files or Grinders on Parts.
2. Assembly Preparations that need to be done prior to Assembly, This will provide start up lubrication to Motor.
   A. Lubricate O-Ring with Petroleum Jelly (Vaseline) for retention during Assembly.
   B. Freely Lubricate all Bearings and finished Parts surfaces with Clean Hydraulic Oil.
3. Fixed clearance of Piston Slipper Flange and Slipper Retaining Plate (See Figure 66), **A.** Measure distance between the bottom of Retainer Strap to top of Thrust Plate this is the height of Spacer. **B.** Measure distance from top of Slipper Retainer Flange to top of Thrust Plate. **C.** Measure the distance between bottom of Retaining Strap and the top of Slipper Retainer Strap. You can also get this by subtracting distance in B from distance in A. Fixed Clearance MUST NOT exceed .008" (.20 mm). If fixed displacement exceeds this measurement replace worn parts. Example, (A.) Spacer Height - (B) Top of Slipper Retainer Plate to Top of Thrust Plate = (C.) Fixed Clearance not to exceed .008" (.20 mm)

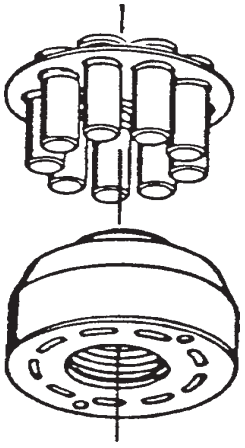

FIGURE 65

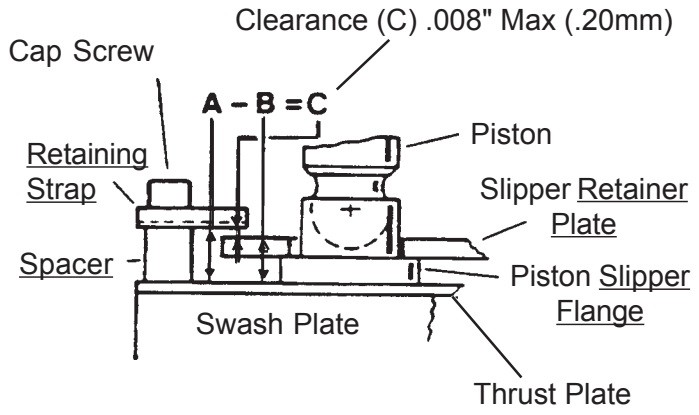

FIGURE 66

4. Lubricate and install Slipper Retainer Plate and Piston Slippers in Cylinder Barrel Assembly. After installation, Freely lubricate Brass Slipper Faces with Clean Hydraulic Fluid.
5. Before assembling Motor any further, You MUST check Fixed Clearance of Unit as shown in Figure 66, Do this by measuring Height of Retaining Strap Spacer with a Micrometer or Vernier Calipers. Spacers are critical to the unit design and may not be adjusted.

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BEARING CONE / OUTPUT SHAFT ASY. & CYLINDER BARREL & SWASH PLATE RE-ASSEMBLY:

1. After checking fixed clearance, continue with assembly of Cylinder Barrel Swash Plate, Apply 1 or 2 drops of Loctite (No. 271 or equal) in first and second thread in each of the four holes (Figure 67). **CAUTION:** Loctited parts must contact only those surfaces intended for assembly, Wipe any excess Loctite from Swash plate with Non-Petroleum Base Solvent applied to a Lint free Cloth. DO NOT apply Loctite to threads more than 15 minutes before installing Cap Screws, If Locktite stands for more than 15 minutes, Repeat Loctite application (It will not be necessary to remove previously applied Loctite.
2. Lightly lubricate and then install Thrust Plate, Aligning Cap Screw Holes, Install Spacers, retaining strap and Cap Screws on one side of the Swash Plate. DO NOT tighten Cap screws at this time. (Figure 68)

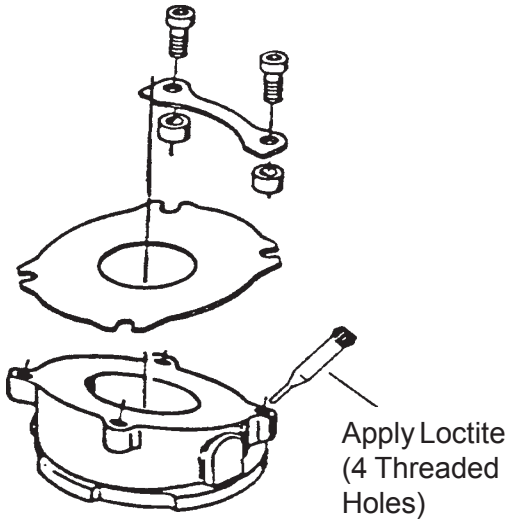

FIGURE 67

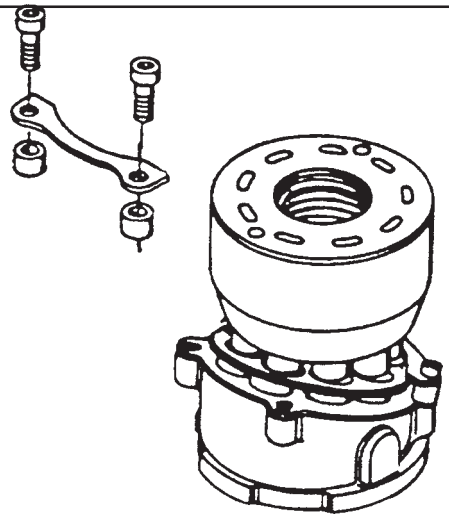

FIGURE 68

3. Place Cylinder Barrel Assembly on Clean, Flat Surface with Piston Slippers pointing upward, Carefully install Swash Plate on Cylinder Barrel by slightly lifting side without Retaining Strap. Slide Swash Plate over to engage installed Retaining Strap. Slide Swash plate over to engage installed Strap around Piston retainer.
4. Carefully reposition Cylinder Barrel and Swash Plate with Swash Plate in down position. Install remaining Spacers, Retaining Strap and Cap Screws in Swash Plate (remember Loctite Rule in Step 1). Tighten all four Cap Screws 16 to 19 ft. lbs. (22 to 26 nm)
5. An alternate method of checking fixed clearance is using a Feeler Gauge. If using this method, make sure Gauge is inserted between Retaining Strap and Slipper Retainer Plate Only. Piston Slipper faces could be damaged if Gauge is inserted between Piston Slippers and Thrust Plate.
6. Carefully reposition Cylinder Barrel Assembly and Swash Plate so that Cylinder Barrel Face is on Clean Flat Surface. Lubricate and install Output Shaft Sub-Assembly (Figure 62) in Barrel Sub-Assembly (Figure 68).

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MOTOR P/N 02967193 - ASSEMBLY

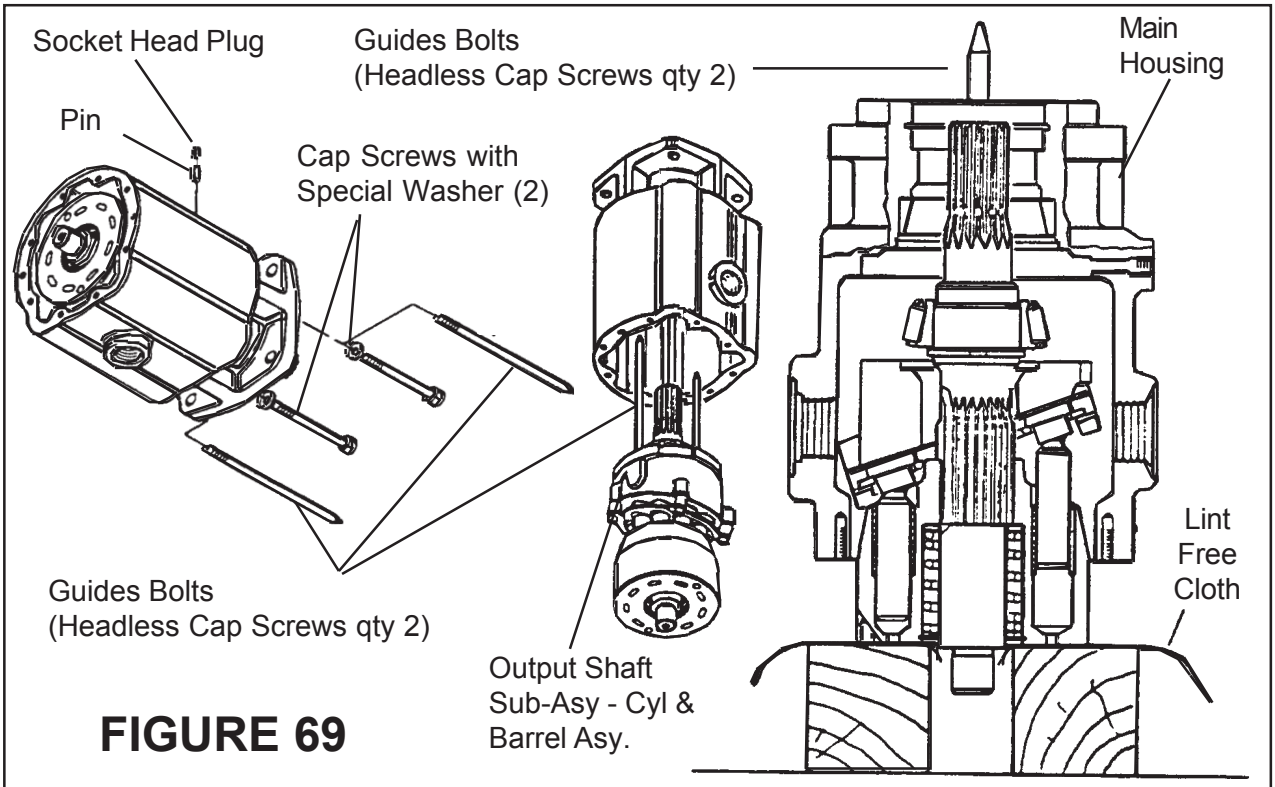

FIGURE 69

MAIN HOUSING RE-ASSEMBLY: (Figure 69)

1. Install two headless 5/16" Cap Screws (5 to 6") Long in Swash Plate. These Cap Screws can be made by sawing off Head and Grinding end to a smooth semi-blunt point. These Cap Screws will Guide Swash Plate into Pocket of Main Housing. These Headless Bolts are for assembly use only.
2. When installing Cylinder Barrel and Swash Plate into Housing, Align Dowel Pin in with notch in Swash Plate.
3. Carefully slide Housing over Output Shaft Sub-Assembly, Swash Plate and Cylinder Barrel Assembly.
4. Carefully Holding Cylinder Barrel Assembly in position in Housing, Reposition Motor on its side and remove the Headless Cap Screw and replace them with the retaining Cap Screw with NEW Special Washers on them, Do this by removing ONE Headless Cap Screw and replacing it then the other. ONLY snug the two cap Screws.
5. Tighten the two Cap Screws in increments alternating from one to the other till they are torqued to 20 to 24 ft. lbs. (27 to 33 nm).
6. After Assembly keep this Component covered to keep Dust or other Contaminates out.

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MOTOR P/N 02967193 - ASSEMBLY

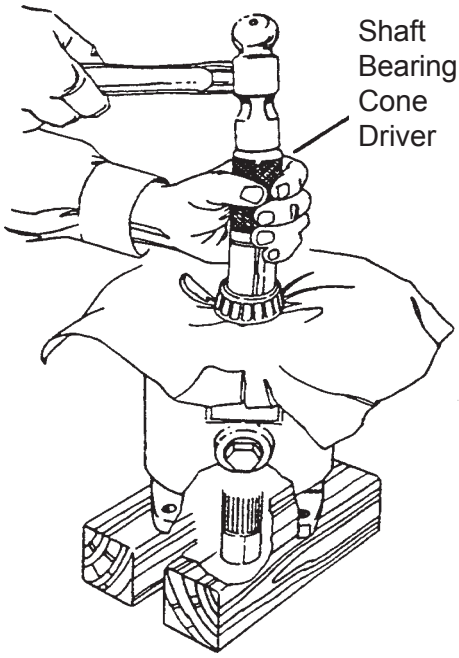

FIGURE 70

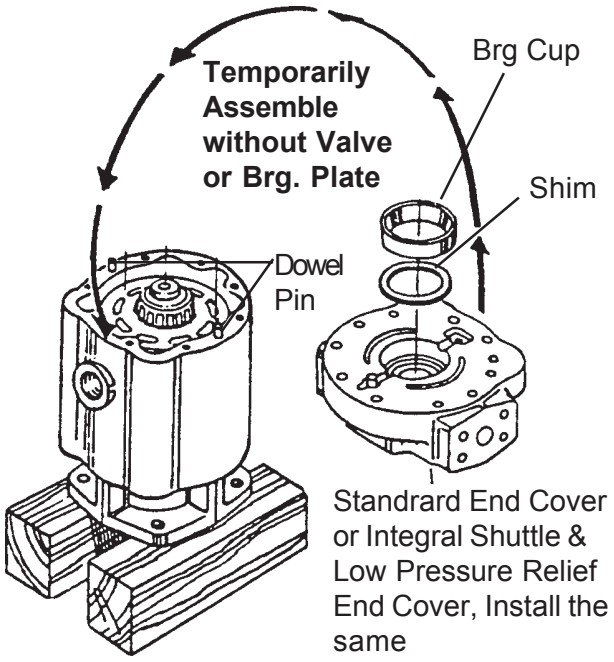

FIGURE 71

END COVER & END COVER BEARING RE-ASSEMBLY:

1. Position and support Motor on Mounting Flange as shown in Figure 71, Support the Output Shaft in a slightly raised position. Use a Press or Bearing driver and install Bearing Cone onto Output Shaft as shown in Figure 70. Bearing Cone MUST seat against shoulder of Output Shaft. REMEMBER: Do not install Bearing Cone unless Output Shaft is supported on Bottom.
2. Install two Dowel Pins in Main Housing and Install Gasket on End Cover (Figure 71)
3. Lubricate and install Bearing Cup Shims and Bearing Cup into End Cover, Be sure Bearing Cup and Shims are seated completely in End Cover (Figure 71)
4. Check Output Shaft Sub-Assembly endplay by installing End Cover without installing either Valve or Bearing Plates. This removes Cylinder Barrels tension against Output Shaft.
5. Install Cap Screws in End Cover and slowly and evenly tighten them. Torque Cap Screws to 39 ft lbs.
6. Place and support Motor Assembly on End Cover, Gently tap Output Shaft inward with Hammer.
7. Install Magnetic Base Indicator on Mounting Flange with Gauge on Output Shaft end (Figure 72). Use Pliers to grip Output Shaft as low as possible. Pry Upward to determine Shaft EndPlay. Indicator must read .002" to .007" (.05 to .17 mm) Shaft endplay. If endplay is incorrect, adjust by adding or removing Shims under Bearing Cup in End Cover.
8. After adjusting endplay, Reposition Motor on mounting flange, remove End Cover (Figure 73)
9. Install two Dowel Pins in face of Cylinder Barrel Sub-Assembly, Freely lubricated Bearing Plate with clean Hydraulic Fluid, Align Bearing Plate with Dowel Pins (Figure 73) and install it on Cylinder Barrel Assembly
10. Install Valve Plate Dowel Pins in face of End Cover. Using Petroleum Jelly, Lightly coat side of Valve Plate facing End Cover. This will retain plate during Assembly. Install Valve Plate over Bearing Cup, Aligning it with Dowel pins, Valve Parts must rest flat and be flush with End Cover.

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MOTOR P/N 02967193 - ASSEMBLY

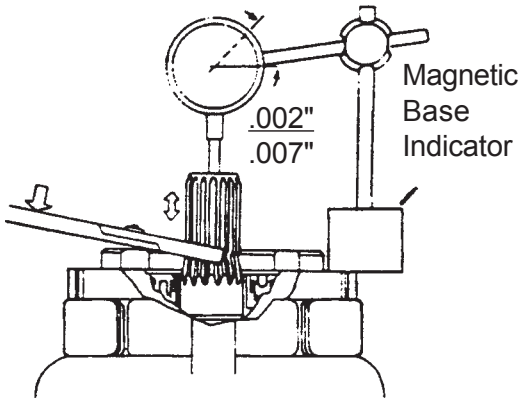

FIGURE 72

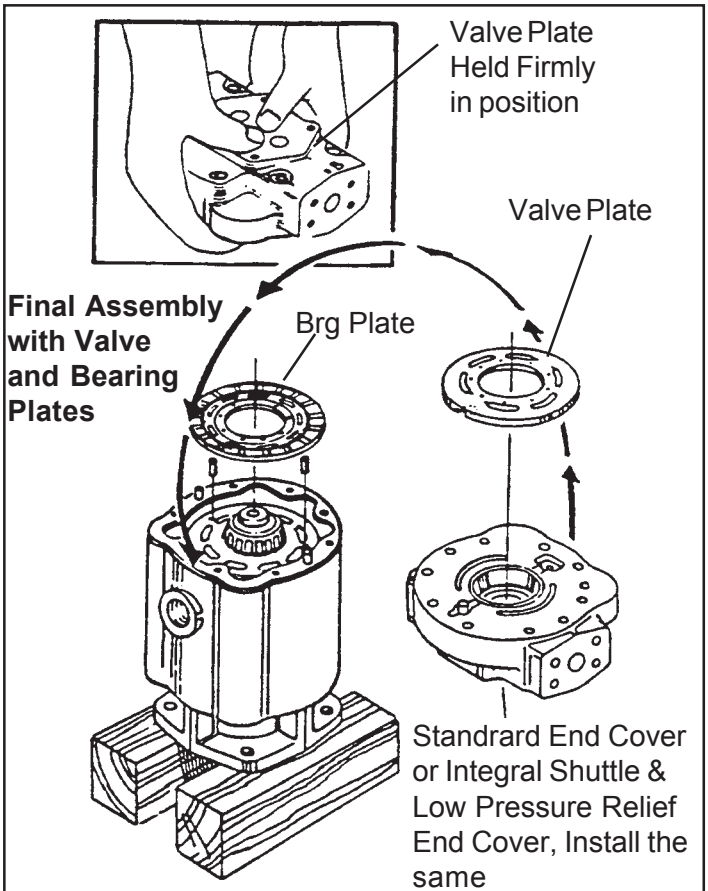

FIGURE 73

11. Hold Valve Plate firmly in position. Install End Cover on Housing. (Figure 73)
12. Install Cap Screws in End Cover, Slowly and evenly in a star pattern tighten them. Torque Cap Screws to 39 ft. lbs. Then a second time go back and recheck Torque making sure they are 39 ft. lbs. (53 nm) using the star pattern.
13. IMPORTANT: Get the New Shaft Seal. The New Shaft Seal is coated with a Rust Preventative that MUST be removed before installation. Clean the Seal Parts with a suitable solvent then Blow Dry. The Metal to Metal Sealing Surfaces are CRITICAL; The Solvent MUST EVAPORATE without leaving a residue. DO NOT touch the Sealing surfaces after cleaning.
14. Lubricate Inner O-Ring of Rotating Seal. Then install Rotating Seal with Seal Puller (Owatonna Tool Co. No. CAS-1844). Ensure that Rotating Seal O-Ring is placed inside the Rotating Seal before assembling onto the Drive Shaft.

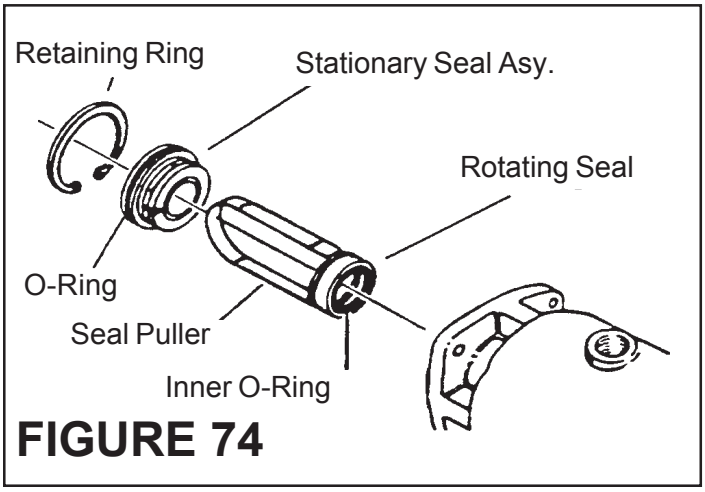

FIGURE 74

15. Lubricate O-Ring Seal of Stationary Seal assembly (Figure 74). Then install Stationary Seal Assembly .
16. Use a No. 5 or No. 7 retaining Ring Pliers to install Retaining Ring, Be Sure to install Retaining Ring with Beveled Side Out.

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MOTOR P/N 02967193 - ASSEMBLY

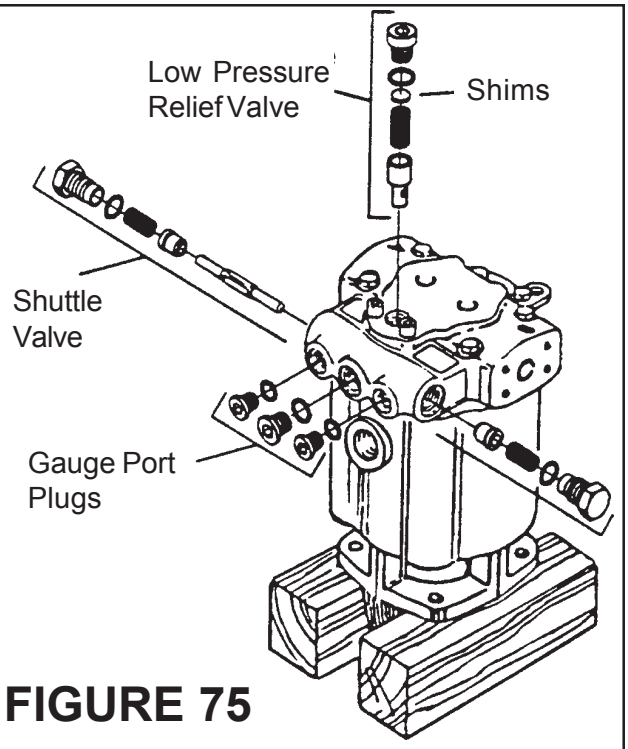

FIGURE 75

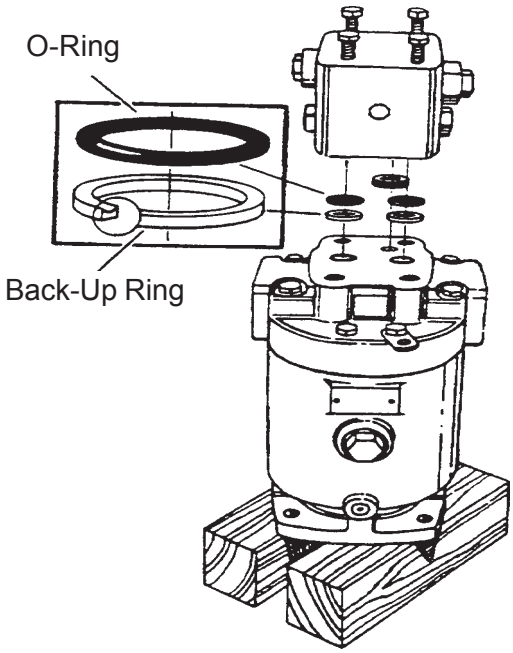

FIGURE 76

INTEGRAL SHUTTLE AND LOW PRESSURE RELIEF VALVE INSTALLATION: (Figure 75)

1. If you have not assembled this yet (See Figure 56 on previous Pages) assemble Shuttle Valve and Low Pressure Relief Valve now, See Figure 75.
2. Install the Gauge Port Plug Assemblies, The two outer Ports have smaller plugs. Torque all three plugs 25 to 31 ft. lbs. (18 to 23 nm).
3. Lubricate and install the Shuttle Spool, (Figure 75) it slides into hole between Shuttle Valve Plugs into the End Cover. Make sure the Shuttle valves are installed correctly, With the smaller ends facing the center of the Spool.
4. Install the Shuttle Valve Springs and Plugs (Figure 75). Torque Plugs 68 to 82 ft. lbs. (92 nm).
5. Install the Low Pressure Relief Valve Plunger and Spring. Lubricate and insert the Shims in the relief Valve Plug, Remember use same amount of Shims that was taken out. Install New (Lubricated) O-Ring on Plug, Install Plug over Spring making sure the Shims are not dislodged. Screw the Plug in and Torque it 68 to 82 ft. lbs. (92 nm).

VALVE BLOCK INSTALLATION: (Figure 75)

1. Valve Block should already be Assembled (See Figures 52, 53, 54 and 55 on previous pages).
2. Install O-Rings and Back-Up Rings on the Valve Block, The High Pressure Ports require an O-Ring and Back-Up Ring. The O-Ring goes on first, then the Back-Up Ring as shown in Figure 76. Install the Square Cut Ring in Low Pressure Port of Valve Block. Note: DO NOT damage O-Rings and Back-Up Rings. Use clean Petroleum Jelly to hold O-Rings in place during block Installation.
3. Install Valve Block on End Cover, install four Hex Hex Bolts, and Torque them 28 ft. lbs. (38 nm)
4. There is a Valve Block Seal Kit # 02972094 that will included these O-Rings and Back-Up Rings in it, These need to be replaced any time the Motor is removed.

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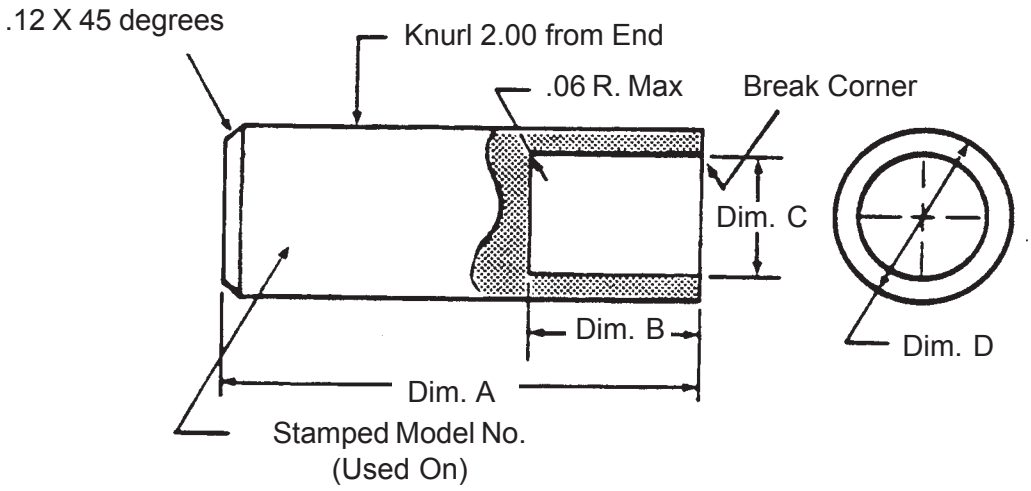
MOTOR P/N 02967193 - TORQUE SPEC'S

TORQUE SUMMARY SPECIFICATIONS:

Component Where Used	Model (C.I.D) 3.3, 3.9, 4.6 C.I.D.	5.4, 6.4 C.I.D.
End Cover Bolts	39 ft. lbs. (53 nm)	63 ft. lbs. (85 nm)
Gauge Port Plugs	25 ft. lbs. (34 nm)	25 ft. lbs. (34 nm)
Relief Valve, (Low-Pressure)	75 ft. lbs. (100 nm)	75 ft. lbs. (100 nm)
Relief Valve, (High Pressure)	25 ft. lbs. (34 nm)	25 ft. lbs. (34 nm)
Relief Valve, (Feathering)	25 ft. lbs. (34 nm)	25 ft. lbs. (34 nm)
Shuttle Valve Cap	68 ft. lbs. (92 nm)	68 ft. lbs. (92 nm)
Socket Pipe Plug	16 ft. lbs. (22 nm)	16 ft. lbs. (22 nm)
Swash Plate Cap Screws	24 ft. lbs. (32 nm)	24 ft. lbs. (32 nm)
Swash Plate Retaining Strap	19 ft. lbs. (26 nm)	26 ft. lbs. (26 nm)
Valve Block Mountin Bolts	28 ft. lbs. (38 nm)	28 ft. lbs. (38 nm)

MOTOR - TOOL DESCRIPTION

SHAFT BEARING CONE DRIVER
(End Cover End)



Material C.R.S. Harden to Rc 50 - 55

Model (C.I.D)	Dim. A	Dim. B	Dim. C	Dim. D
3.3, 3.9, 4.6	4.0	1.5	1.01	1.25
5.4, 6.4	4.0	1.5	1.30	1.48

FIGURE 77

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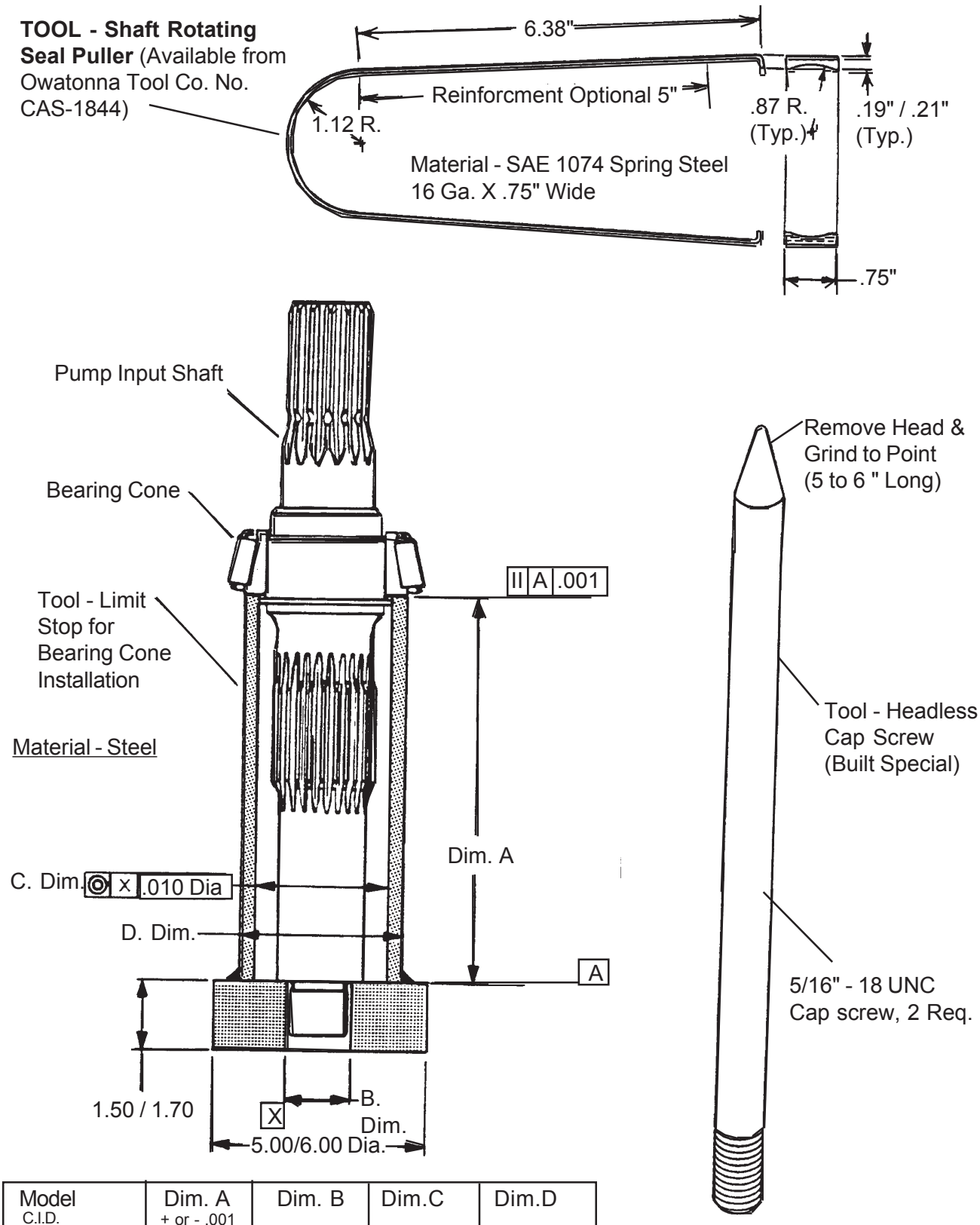
MOTOR P/N 02967193 - TOOL DESC.


TOOL - Shaft Rotating Seal Puller (Available from Owatonna Tool Co. No. CAS-1844)
6.38"
Reinforcment Optional 5"
1.12 R.
.87 R. (Typ.)
.19" / .21" (Typ.)
Material - SAE 1074 Spring Steel
16 Ga. X .75" Wide
.75"
Pump Input Shaft
Bearing Cone
Tool - Limit Stop for Bearing Cone Installation
Material - Steel
II A .001
Dim. A
C. Dim. X .010 Dia
D. Dim.
A
1.50 / 1.70
X
B. Dim.
5.00/6.00 Dia.
Remove Head & Grind to Point (5 to 6 " Long)
Tool - Headless Cap Screw (Built Special)
5/16" - 18 UNC Cap screw, 2 Req.

Model C.I.D.	Dim. A + or - .001	Dim. B	Dim.C	Dim.D
3.3, 3.9, 4.6	5.803	1.00/1.20	2.20/2.30	3.00 Min.
5.4, 6.4	6.682	1.30/1.32	2.25/2.35	3.00 Min.

FIGURE 78

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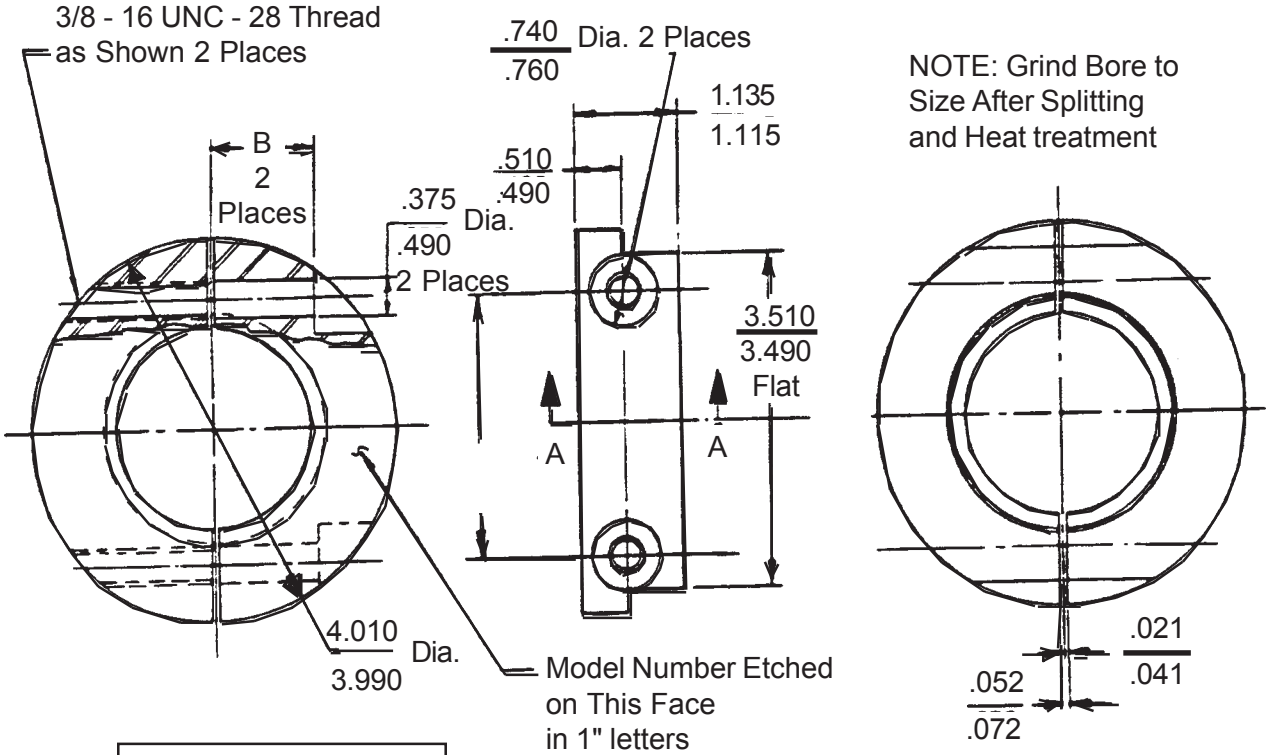
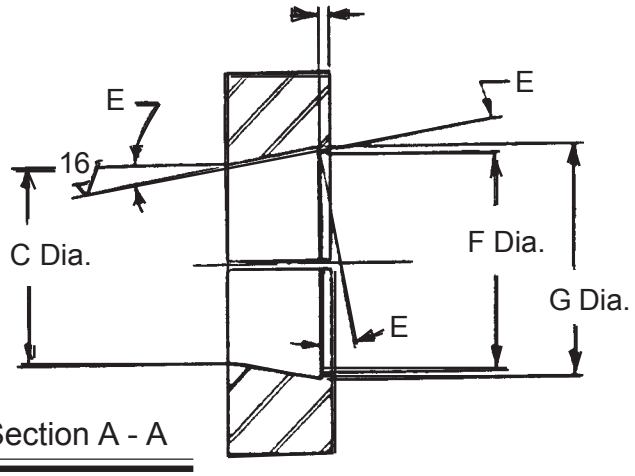
MOTOR P/N 02967193 - TOOL DESC.

LOW CLEARANCE BEARING PULLER



Stenter / 45 - 55 Rc
Cone Bearing Puller

	Displacement Cu. in. / Rev	
	3.3, 3.9, 4.5	5.4, 6,4
B	1.050 / 1.070	1.115 / 1.135
C	1.565 ref.	1.603 ref.
D	.135 / .129	.141 / .135
E	13 deg.	20 deg.
F	1.907 / 1.913	2.223 / 2.229
G	2.020 / 2.026	2.318 / 2.324
H	2.622 / 2.628	2.747 / 2.753



Section A - A

FIGURE 79

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NOTES

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MOTOR P/N 02979881

Parts Location & Service Instructions

This Section is for Motor Asy P/N 02979881

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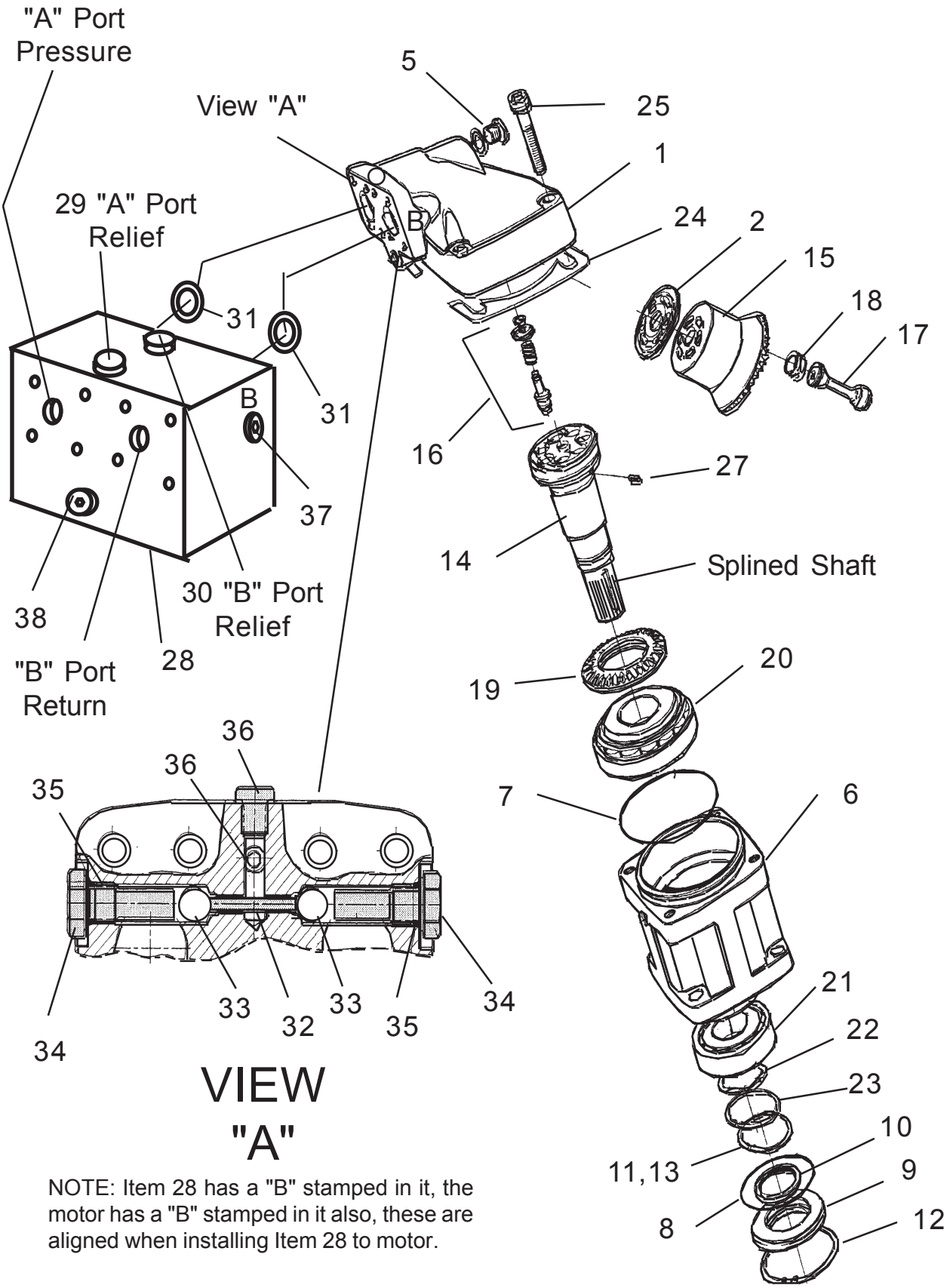
MOTOR P/N 02979881 - PARTS LOCATION



NOTE: Item 28 has a "B" stamped in it, the motor has a "B" stamped in it also, these are aligned when installing Item 28 to motor.

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MOTOR P/N 02979881 - PARTS LOCATION

50" Rotary Head

Item	Part No.	Qty	Description
	02979881	-	50" Motor Asy
1.	02980529	1	Barrel Housing Asy.
2.	02980530	1	Vlalve Plate (*)
4.	02980536	1	Nozzle
5.	02980537	1	Plug Asy. Hexagon
6.	02980538	1	Bearing Housing
7.	02980539	1	O-Ring (*) (**)
8.	02980540	1	O-Ring(*) (**)
9.	02980541	1	Seal Carrier
10.	02980542	1	Shaft Seal (*) (**)
11.	02980543	1	Spacer Washer
12.	02980544	1	Retaining Ring
13.	02980545	1	Retaining Ring
14.	02980546	1	Shaft Asy
15.	02980548	1	Cylinder Barrel (*)
16.	02980549	1	Barrel Support
17.	02980550	7	Piston Asy. (*)
18.	02980551	21	Piston Ring
19.	02980552	1	Ring Gear
20.	02980553	1	Bearing, Roller
21.	02980554	1	Bearing, Roller
22.	02980555	a/r	Spacer Washer
23.	02980556	1	Retaining Ring
24.	02980557	a/r	Shim 0.5
	02980558	a/r	Shim 0.2
	02980559	a/r	Shim 0.4
	02980560	a/r	Shim 0.6
	02980561	a/r	Shim 0.8
	02980562	a/r	Shim 1.0
	02980563	a/r	Shim 0.7
25.	02980564	4	Bolt, Socket Head
26.	02980565	1	Safety Valve
27.	02980547	1	Guide Pin
28.	02980571	1	Relief Manifold
	02980570	a/r	Relief Valve Seal Kit
29.	02960568	1	Relief Valve, 280 Bar (A-Port)
30.	02980569	1	Relief Valve, 330 Bar (B-Port)
31.	02980237	2	O-Ring
33.	02980532	2	Ball
34.	02980533	2	Plug, Hexagon
35.	02980534	2	O-Ring
36.	02980535	2	Plug, Asy.
37.	02980572	2	Plug Asy.
38.	02980573	1	Plug Asy.
39.	02980566	1	Rebuild Kit (*)
40.	02980567	1	Seal Kit (**)

(**) These parts are included in Seal Kit

(*) These parts are included in Rebuild Kit

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MOTOR P/N 02979881 - SPECIFICATIONS

Motor P/N 02979881 Specifications [3]

		European Standards		United States Standards
Displacement.....		80.4 (Cm / Rev)	or	4.9 (Cu. In. / Rev
Motor Operating Speed.	Max Intermittent...	5,200 rpm	or	5,200 rp
	Max Continous....	4,000 rpm	or	4,000 rp
	Min Continous.....	50 rpm	or	50 rpm
Motor Torque (Theor.).....		128 NM (at 100 Bar)	or	94 ft.lbs. (at 1450 psi)
		614 NM (at 480 Bar)	or	453 ft. lbs (at 6960 psi)
Motor Input Flow.....	Max Intermittent....	418 L/min	or	110 gpm
	Max Continous....	322 L/min	or	85 gpm
Operating Pressure.....	Max Intermittent....	480 Bar	or	6960 psi
	Max Continous.....	420 Bar	or	6100 psi
Maximum Case Pressure.....		10 bar (at 1500 rpm)	or	145 psi (at 1500 rpm)
Fluid Contamination Level.....		18/13 (ISO Code 4406)	or	18/13 (ISO Code 4406)
Motor Shipping Weight.....		26 kg	or	57 lbs.

Specifications Subject To Change Without Notification

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MOTOR P/N 02979881 - PARTS LOCATION

General Information:

The Motor P/N 02979881 is Sperical Piston design. This motor is used on the Rotary Head (the 50 inch only at this time March 2004). This is a high Torque Motor, with heavy duty roller bearings. See Figure 1 below for component location.

1. Barrel Housing
2. Valve Plate
3. Cylinder Barrel
4. Piston with Piston Ring
5. Timing Gear
6. Tapered Roller Bearing
7. Bearing Housing
8. Shaft Seal
9. Output / Input Shaft

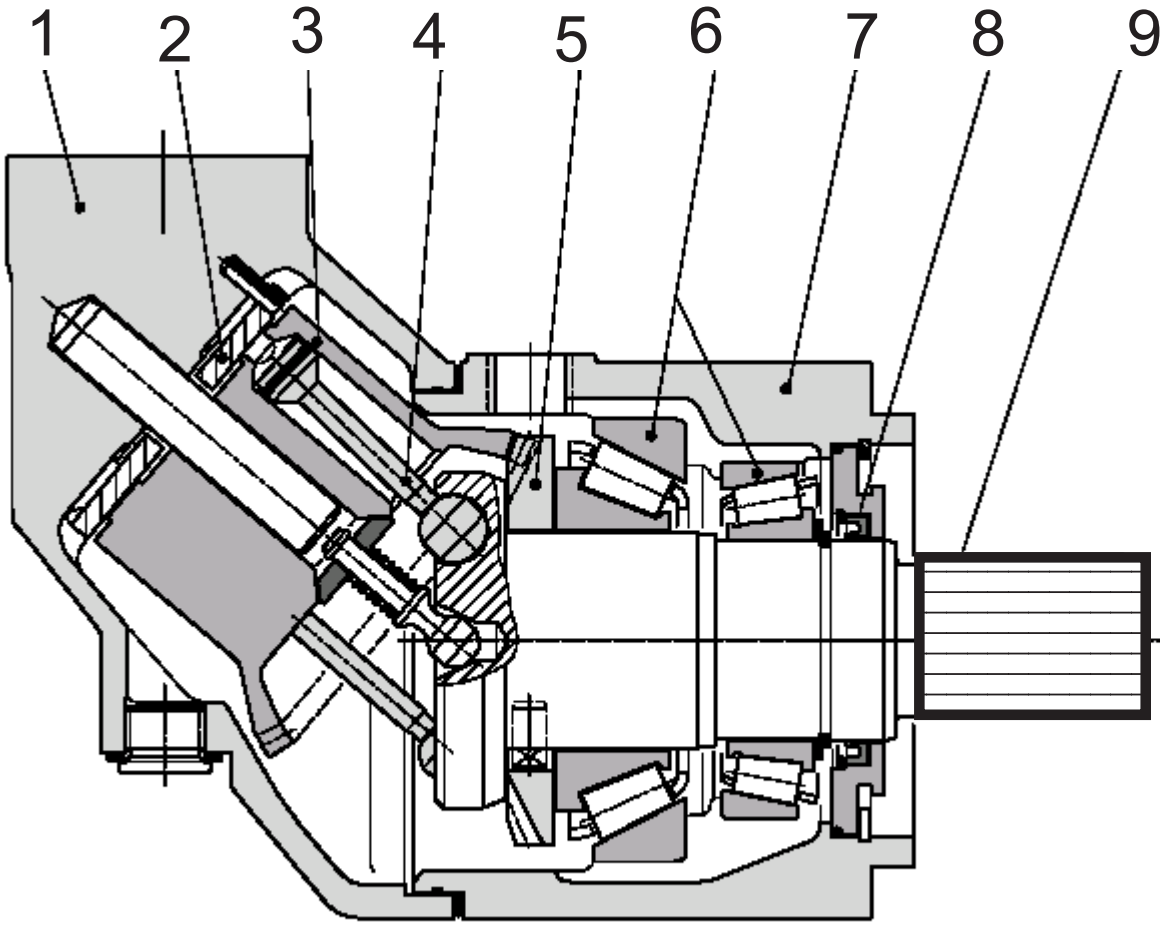

Figure 1 Motor Assembly

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MOTOR P/N 02979881 - DISASSEMBLY

Motor Disassembly:

1. Clean Outer Surface Motor , hose and deck surfaces Before removing any components. Motor and hoses must be completely clean, dry the exterior of the motor and hoses. Make certain that you have proper containers to catch any oil that will drain out. Plug all hoses that are removed and plug all opening of motor fittings. Make certain the work area and all tools are clean. No contamination can be allowed to get into system. Refer to the previous parts page for part location in disassembly instructions, It works well to print a copy and have it laying to one side as you read these instructions. Instructions should be read all the way through prior to beginning disassembly

2. Remove Barrel Housing. Clamp Motor in a vise as shown in figure 1. There are 4 bolts (item 25) located on top of the Barrel Housing Assembly (item 1). Remove these four bolts. Lift Barrel Housing (item 1) as shown in Figure 2. Use caution to make certain the valve plate (Item 2) doesn't fall out when lifting the Barrel Housing off. By lifting straight up you should be able to use your finger to make certain the valve plate (item 2) does not fall out and get damaged. Make a note of which side of Valve plate is up and which side is down, this will be important during reassembly.

3. Remove Cylinder Barrel. Remove the Shim (item 24) and set it aside. Lift the Cylinder Barrel up and out (See Figure 4), This will leave the barrel support components (item 16) sticking up out of the shaft. Support components (item 16) are an assembly of four parts. The pistons (item 17) will also be sticking up. Make certain all the removed components are laid in a clean area.

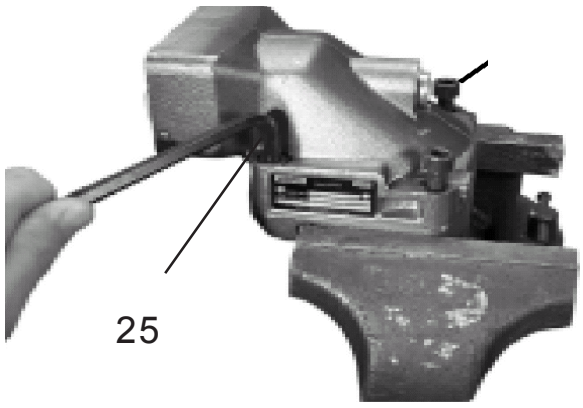

Figure 2

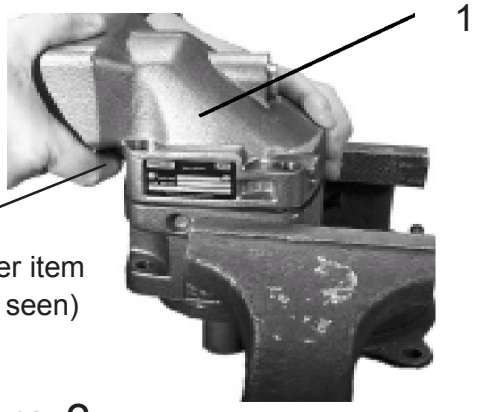

Figure 3

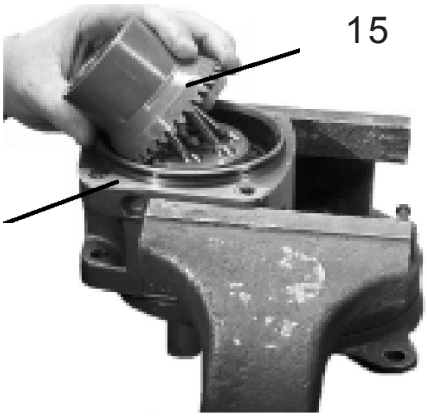

Figure 4

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MOTOR P/N 02979881 - DISASSEMBLY

Motor Disassembly: Continued

4. Lift Out Barrel Support . Lift the barrel support out (item 16), make certain that all the parts in barrel support are accounted for. (See Figure 5)

5. Remove the Pistons (item 17), there are 7 pistons and 21 piston rings (item 18) that will be removed. There are 3 piston rings per piston. (See Figure 6)

6. Remove Bearing Housing Sealing O-Ring. There is an O-Ring (item 7) that is used to seal barrel housing assembly (item 1) to bearing housing (item 6). Remove this O-ring (See Figure 7) This will leave Shaft Assembly (item 14) still in Bearing housing (item 6)

7. Remove Retaining Snap Ring. Remove the Bearing Housing Assembly from vise and turn it over so the shaft end is pointing upward and reclamp it into vise as shown in figure 8. Using internal Snap Ring pliers to remove the snap ring that retains the seal carrier (item 9). Note: Smooth Shaft shown, actual shaft is splined in this motor.

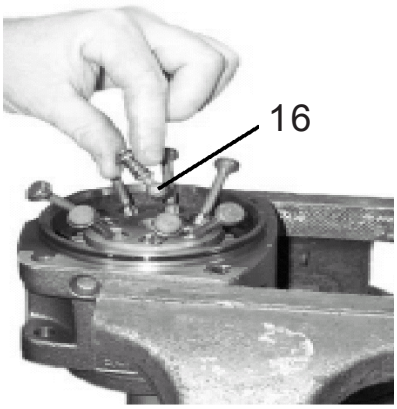

Figure 5

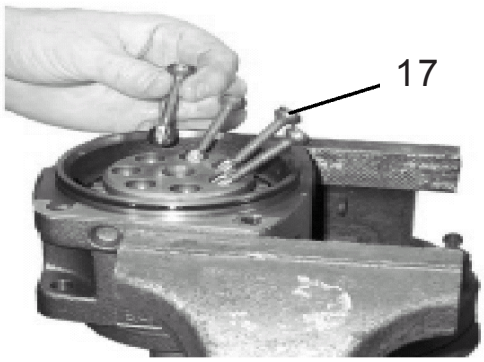

Figure 6

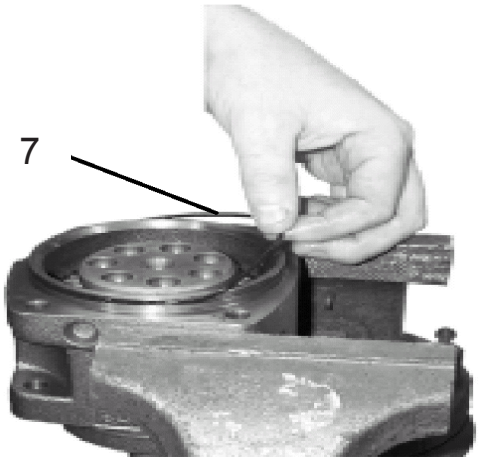

Figure 7

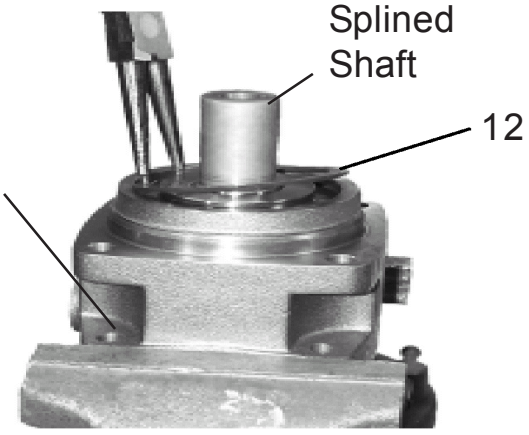

Figure 8

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MOTOR P/N 02979881 - DISASSEMBLY

Motor Disassembly: Continued

8. Remove Seal Carrier . Using small pry tool lift seal carrier (item 9) up and slide it off of shaft as shown in Figure 9.

9. Remove sealing O-Ring. There is an O-Ring (item 8) under seal carrier that you can reach and pull out. (See Figure 10)

10. Remove External Snap Ring From Shaft,. Looking down on the shaft as shown in Figure 11, there are spacer washers (items 11, 13 & 22) and external snap ring. Make certain to make a note of where they are located and how many there are. Use snap ring pliers to remove retaining ring, do not pry it off of shaft as this would scratch the shaft.

11. Remove Spacer Washer. Under the Snap Ring. Remove any spacer washer under the snap ring, noting their quantity and location. (See Figure 12). Make certain to keep all Spacers in the same order they came off.

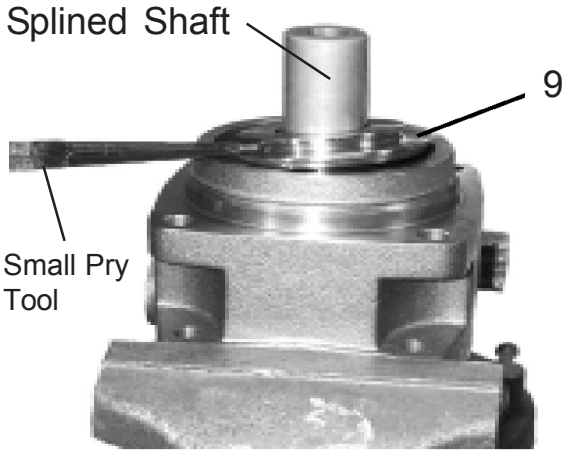

Figure 9

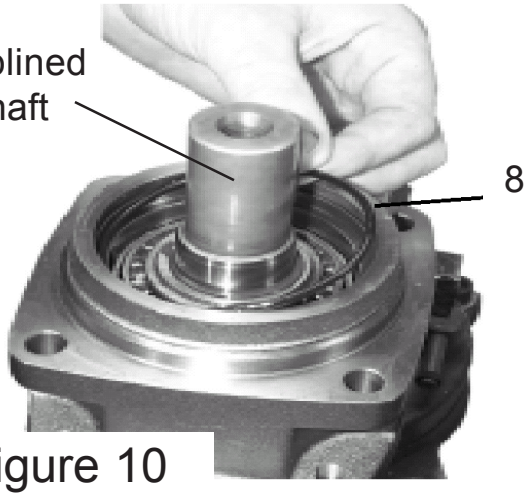

Figure 10

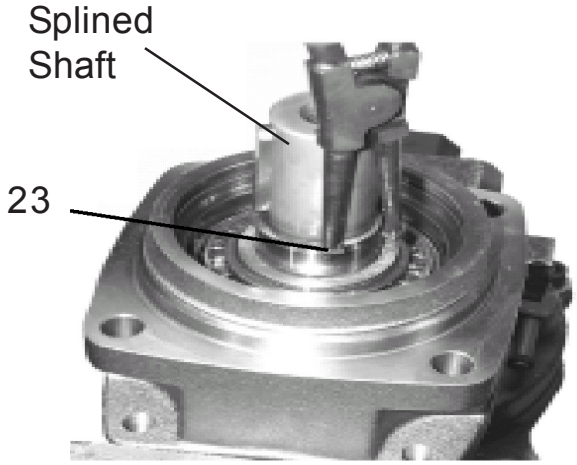

Figure 11

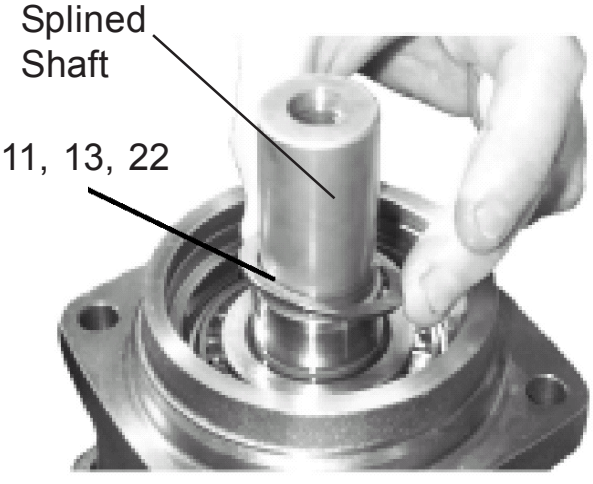

Figure 12

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MOTOR P/N 02979881 - DISASSEMBLY

Motor Disassembly: Continued

12. Remove Shaft. Remove Bearing housing from Vise and move to a press. Set the Housing in press where the bottom is open as the shaft will come out the bottom,. (See Figure 13) Make certain you support the shaft in a way that will not allow it to fall out when pressed and hit the floor. It will not take a lot of pressure to remove shaft so you should be able to catch it with your hand.

13. Remove Small Lower Bearing Cone. The lower bearing cone (item 21) will lift out of the housing once the shaft is removed. (See Figure 14)

14. Remove the Bearing Cups from Bearing Housing (item 6). This will only need to be done if they are being replace. Using a hammer and a mandre, tap the small bearing ring off. (See Figure 15 & 16) The Bearing Cups will drive out from the opposite side of each other. The lower bearing cup is tapped from the top and the upper Bearing cup will be tapped from the bottom side of the housing.

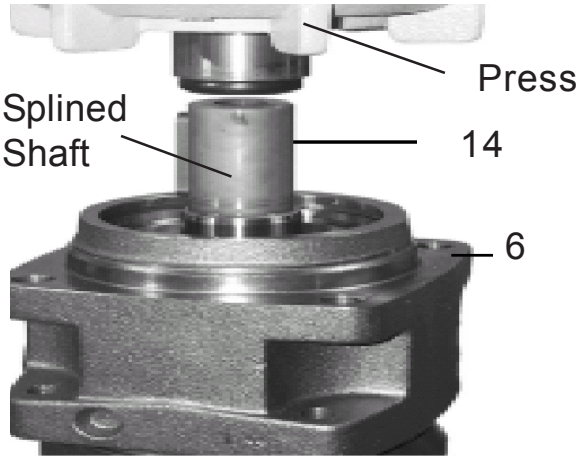

Figure 13

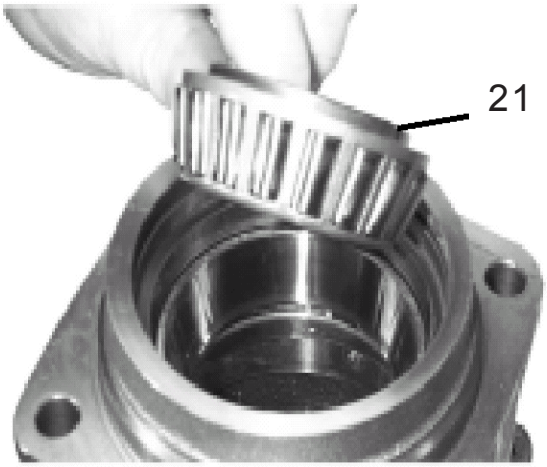

Figure 14

Figure 15

Figure 16

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Motor Disassembly: Continued

15. Remove Gear and Upper Bearing Remove upper bearing cone and gear at the same time. Sit Shaft down over a tube that will support the gear (item 19). Using press on Shaft (item 14) , Shaft will slide down through the gear and bearing at the same time. Make certain to support Shaft in such a way it will not fall through and hit the floor. (See Figure 17) Figure 16

16. Inspect all parts. The Motor is now disassembled. Inspect all of the disassembled part for wear and damage. Replace worn and/or damaged parts. After cleaning and washing parts keep them in clean area. If the motor is to remain disassembled for any period of time, lightly coat the surfaces of the parts with hydraulic oil and store them in a closed container to prevent the parts from rusting or becoming contaminated.

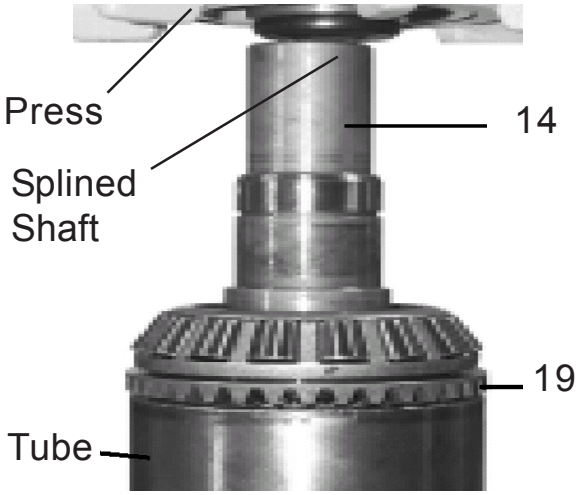

Figure 17

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MOTOR P/N 02979881 - ASSEMBLY

Motor Assembly:

1. Install Gear & Bearing Cone on Shaft. Install Gear (item 19) down over shaft (item 14), make certain Gear is on in correct direction and the guide pin (item 27) is installed. Slide Bearing Cone (item 20) down onto Shaft with small part of Bearing Cone up as shown in Figure 18. Using a tube sleeve (tool shown in last figure of this section) press Bearing cone and Gear down onto shaft with a press. The tube must only contact the inner edge of the bearing. See Figure 40 at the end of this section for tool dimensions.

2. Install Bearing Cups into Bearing Housing. This will need to be done if the bearing cups were removed. Install bearing cups (1/2 of item 20) into Bearing housing using a press and tube that is close to the size of the bearing cup. Make certain the Bearing cups are completly seated. (See Figure 19)

3. Install Shaft Assembly into Bearing Housing. Install the Shaft Assembly (Shaft, Gear and Bearing) into the Bearing housing. Slide the Lower Bearing cone down over Shaft. You will need to support shaft while pressing Bearing Cone onto shaft, make certain to support it with something that will not damage it or get contamination on it. Using a tube and a press to push bearing down until it is seated in Bearing cup, Press Bearing Cone on until the proper Bearing preload is achieved. Proper Bearing Preload is the removal of the slack in the bearing, remove end play.

4. Remove Bearing Housing with Shaft From Press. Remove assembly from press and reinstall it into the vise as was done during disassembly process. Install it with the spline end of the shaft pointing up.

5. Install The Lower Bearing and Spacer Washers. Press lower bearing onto shaft until Zero End play is achieved. Install Lower bearing spacer washer (item 22) Quantity will vary as these shim type spacer washer are used to maintain zero bearing end play. Start with the same quantity that was removed and check. Adjust quantity as required to achieve proper bearing load. (See Figure 21)

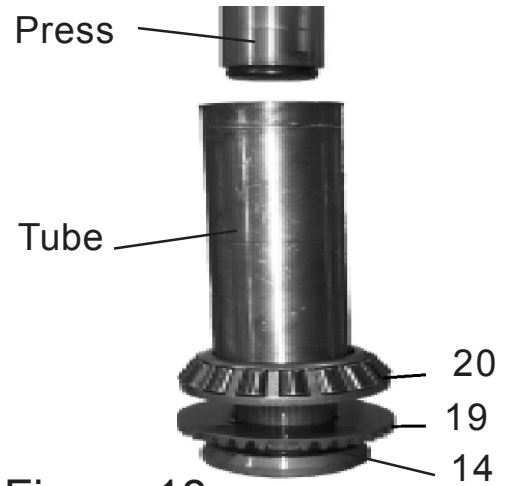

Figure 18

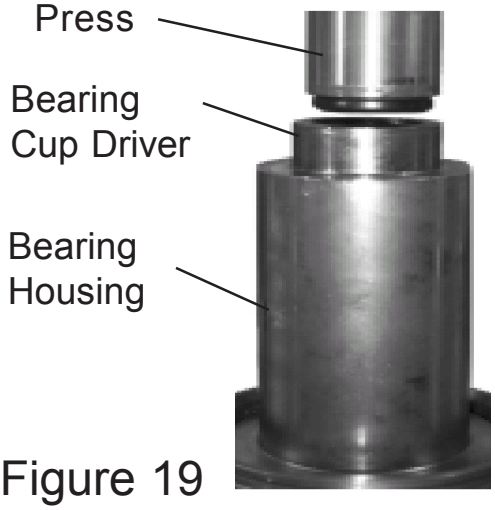

Figure 19

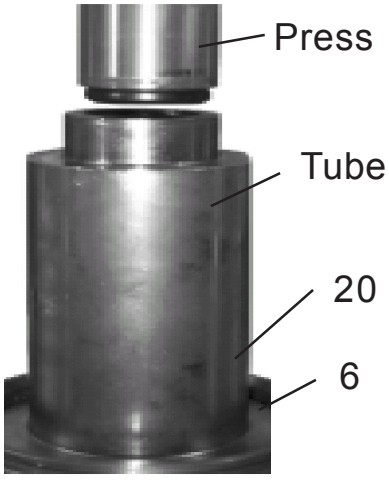

Figure 20

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Motor Assembly: Continued

6. Install Bearing Retaining Ring. This is an external snap ring (item 23). Use snap ring pliers to slide snap ring down over shaft. (See Figure 22). Check Bearing load after snap ring is installed to make certain shaft has zero end play with bearings, If end play is not correct, the snap ring will need to be removed and the quantity of spacer washers will have to be changed.

7. Install O-Ring Seal. Install the O-Ring seal (item 8) into Bearing housing making certain it is straight and seated into housing. (See Figure 23)

8. Install Seal into Seal Carrier. Drive the old Seal out of Seal Carrier (See Figure 24) Install new seal (item 10) using a seal driver. Coat the ID of seal with a light coat of oil. (See Figure 25)

9. Install Seal and Seal Carrier. The Seal Carrier (item 9) has a shaft seal (item 10) that is installed into it. This needs to be installed before Seal carrier is installed into Bearing housing. (See Figure 26)

10. Install Seal Carrier Retaining Ring. Using Internal Snap Ring Pliers Install the retaining ring (item 12) into bearing housing. This will complete the lower end assembly. (See Figure 27) Remove the bearing housing from the vise and turn it over. Reinstall it into the vise with the gear end up. (See Figure 28)

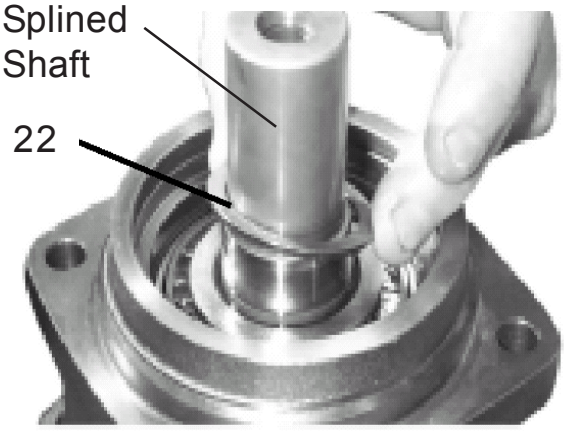

Figure 21

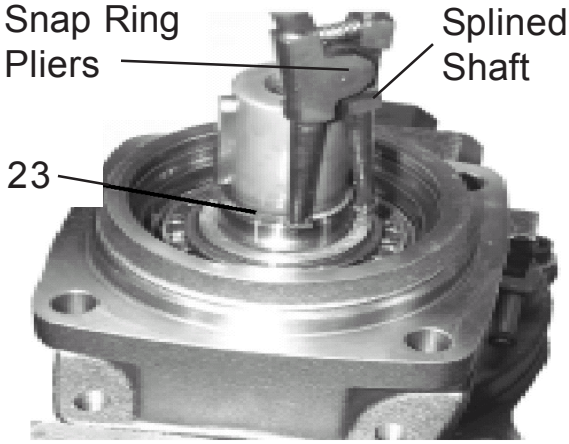

Figure 22

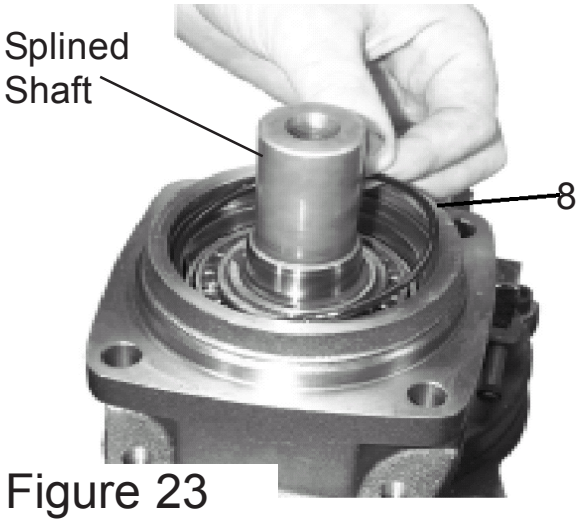

Figure 23

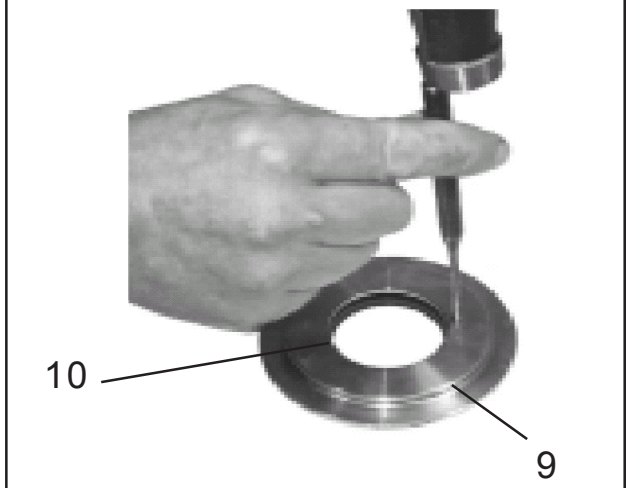

Figure 24

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MOTOR P/N 02979881 - ASSEMBLY

Motor Assembly: Continued

11. Install O-Ring Seal. Install the O-Ring Seal (item 7) into bearing housing (See Figure 28).

12. Install Pistons & Piston Rings. Coat the pistons (item 17) with hydraulic oil, make certain all 7 pistons have 3 rings (item 18) each on them. (See Figure 29). Piston will lay over to the side as shown in figure 29 but will slip down into the holes as shown in Figure 30.

13. Install Barrel Support. The Barrel Support (item 16) is a 4 piece assembly that installs in the center of the shaft, make certain all components of the barrel support is installed. (See Figure 30)

14. Install Shims. Install the bearing housing shims (item 24) onto bearing housing (See Figure 31), These shims are various thickness and the quantity required will vary, start with the same amount and thickness that was removed.

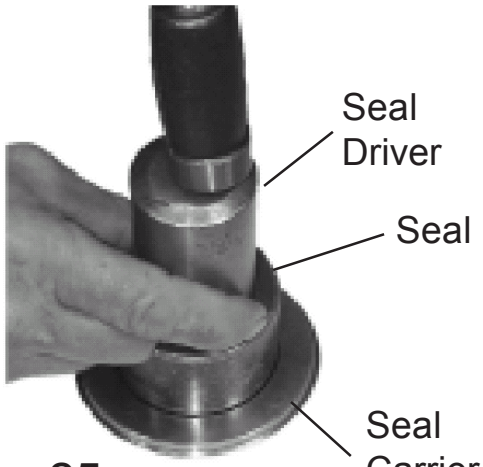

Figure 25

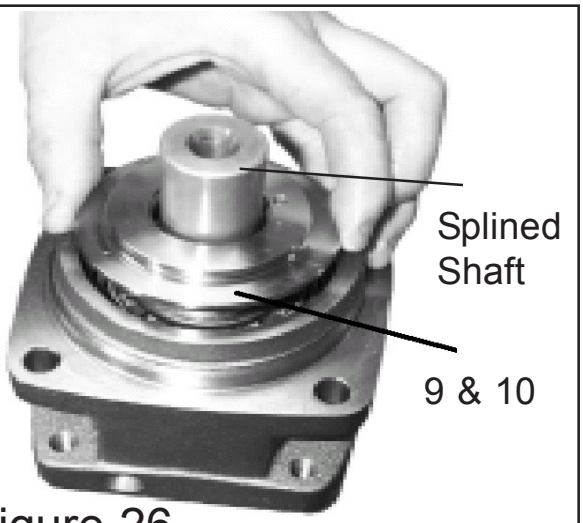

Figure 26

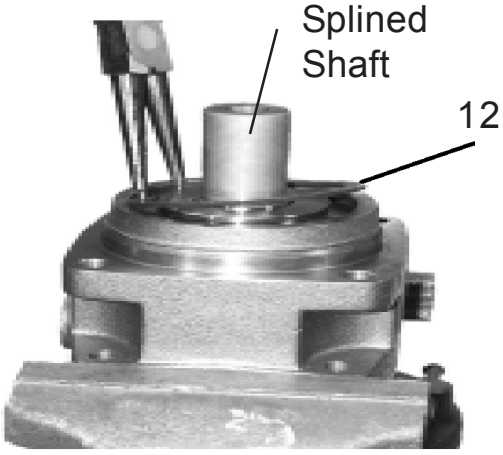

Figure 27

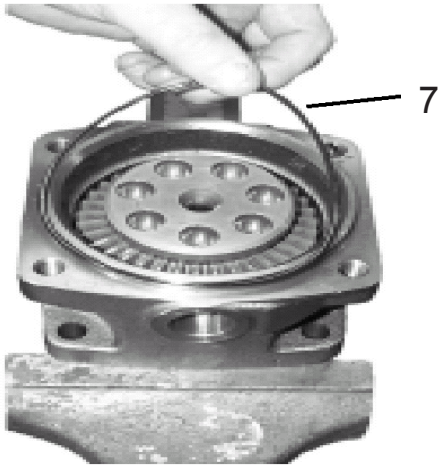

Figure 28

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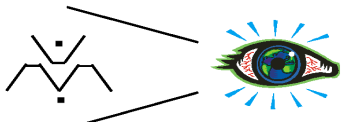
MOTOR P/N 02979881 - ASSEMBLY

Motor Assembly: Continued

15 Install Cylinder Barrel. When installing the **cylinder barrel (item 15), it must be timed.** There are punch marks on the Shaft Gear and the gear of cylinder barrel, these marks must be aligned as shown below. (See Figure 32) Set this assembly aside for now.



16. Install Valve Plate, Coat Valve plate (item 2) with a coat of grease (See Figure 33) will be to hold valve plate in housing during assembly. With the Barrel Hosing assembly in vise install the valve plate into it. This plate must be installed with the correct side down and the correct side up. (See Figure 34). Note the location of the notch in OD of valve plate.

17. Install Barrel Housing. Clamp Bearing housing and Shaft assembly back into the vice. With the barrel housing assembly turned up as shown in figure 35. Make certain the Valve plate (item 2) is installed inside the barrel housing and facing the correct direction. Make certain the Shims (item 24) are still installed on the Bearing housing. Sit the barrel housing (item 1) down over the bearing housing (item 6). Install the four bolts (item 25), and Torque these four bolts using an alternating pattern to 75 ft. lbs. +/- 7 ft lbs (See Figure 36)

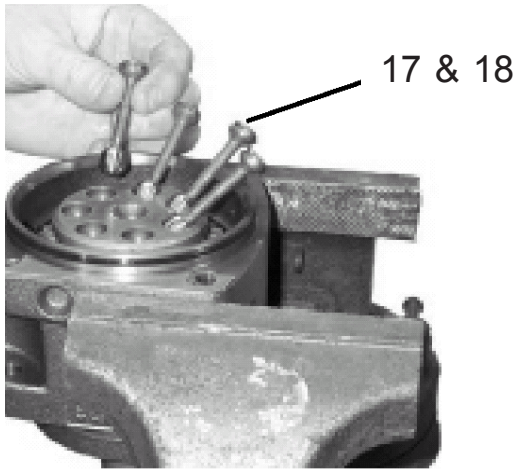


Figure 29

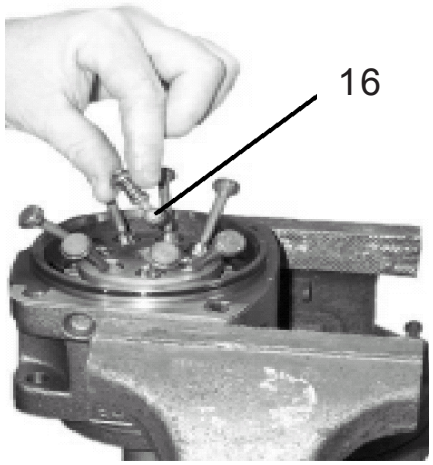


Figure 30

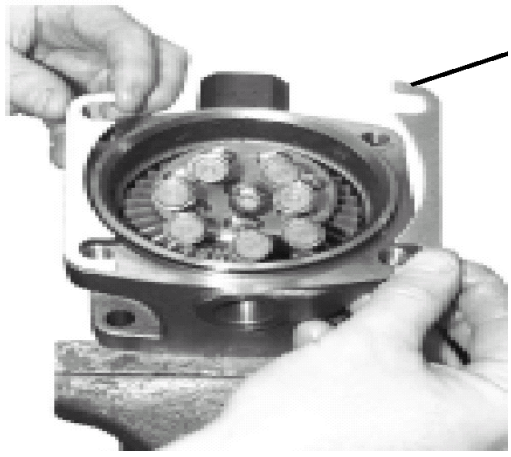


Figure 31

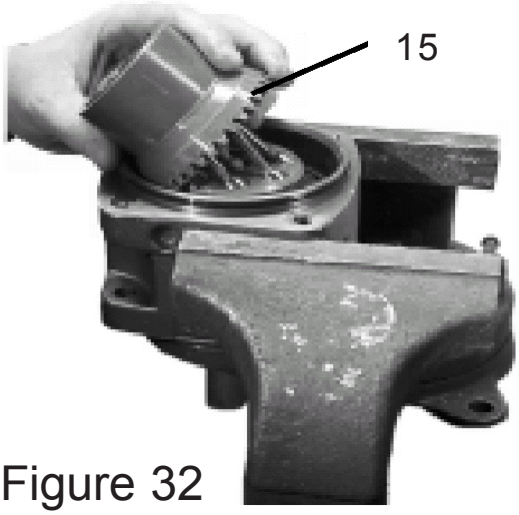


Figure 32

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Motor Assembly: Continued

18. Install Relief Manifold. It would not have been required to remove the Relief Manifold (item 28) to disassemble the motor, it could have been left attached to the Barrel Housing Assembly (item 1) . If it was removed, inspect the O-Rings (item 31) and replace if nessacary. The reliefs (item 29 & 30) would not have had to be removed, but if they were make certain to replace them the same way they were removed, there is a Relief Valve Seal Kit (See item 28) available as repair parts. (See Figure 37)

19. Inspect all assembly steps done and make certain every thing is clean, all opening should be plugged and remain plug until hoseconnections are attached.

20 If only replacing Seal as a repair See Figure 8 & 9 in disassembly section and Figures 24, 25, 26 & 27 in the assembly section.

It will be required to remove Seal Carrier Retaining Ring, Pull Seal Carrier out of pump Bearing Housing and remove seal from seal carrier. Make certain to check the O-Ring Seal under seal carrier, it should be replaced when seal carrier is removed and reinstalled. Reverse procedure to reinstall seal carrier. (See Figure 38 & 39)

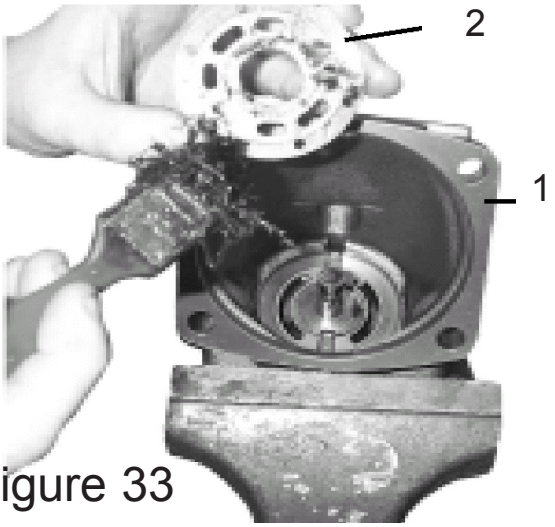

Figure 33

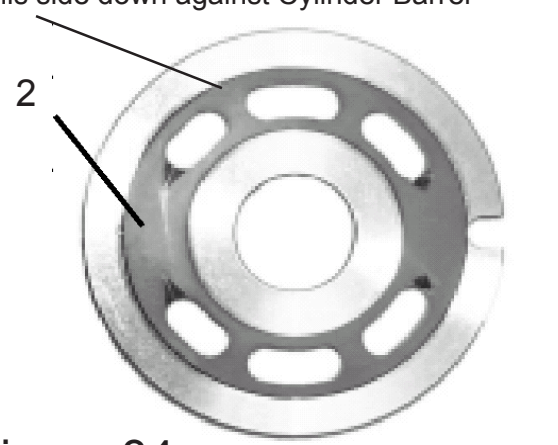

Figure 34

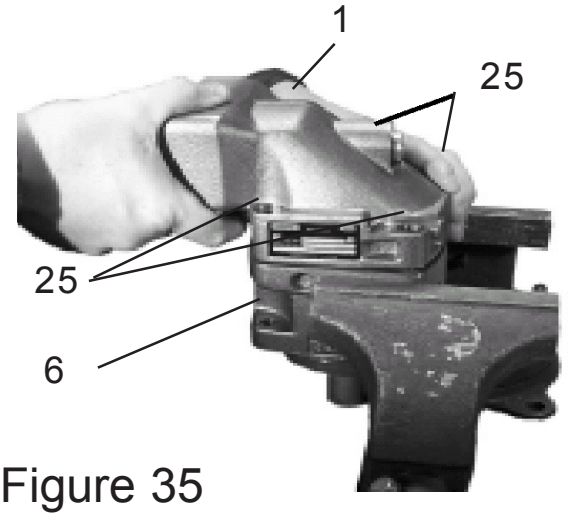

Figure 35

Figure 36

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MOTOR P/N 02979881 - ASSEMBLY

Motor Assembly: Continued

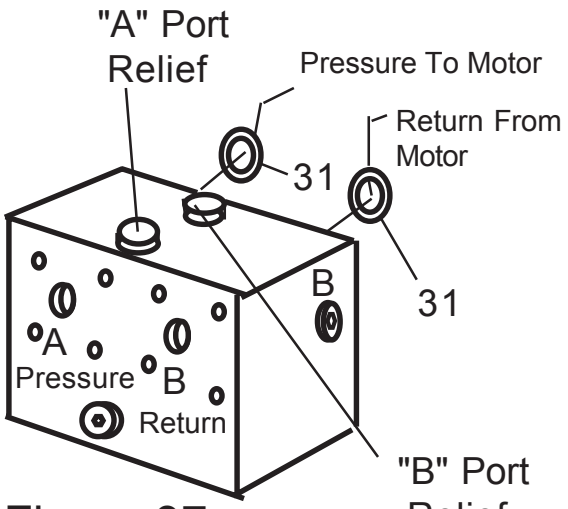


Figure 37

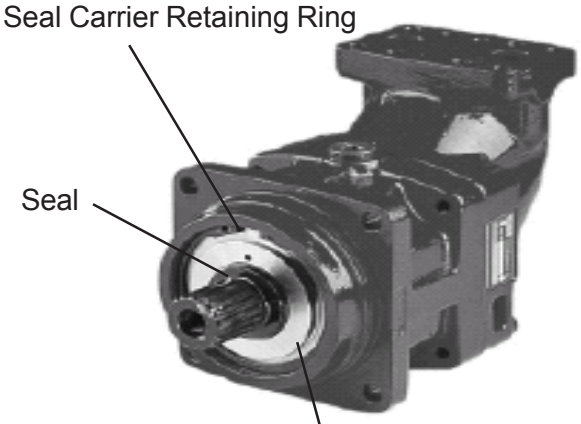


Figure 38

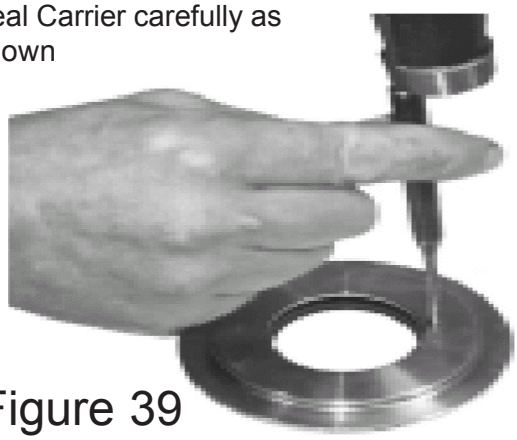
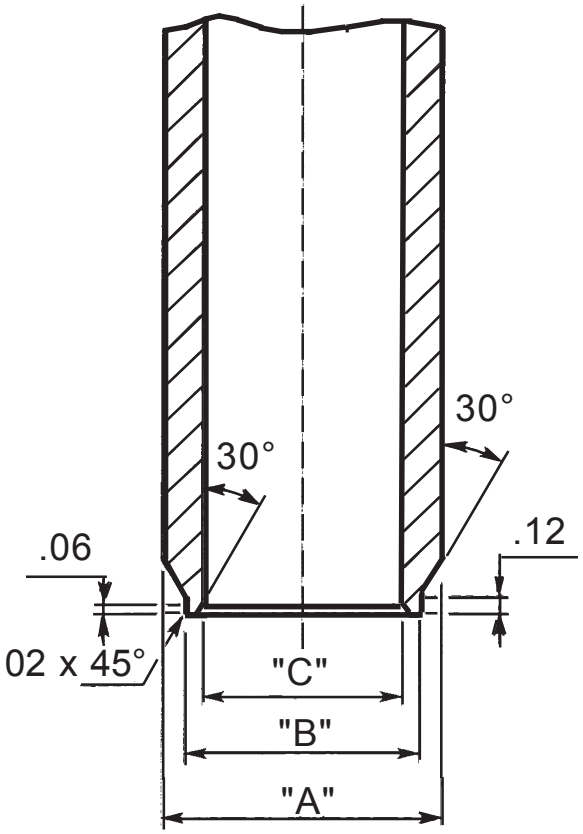


Figure 39

This tool can be machined from tubing to create a bearing driver to install bearings on motor shaft.



Diminsions

"A"	=	2.91" + 0 / -.04
"B"	=	2.75"
"C"	=	2.441" + .008 / - 0

Figure 40

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King Pin Replacement Section

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KING PIN - REPLACEMENT

King Pin Replacement Procedure:

Caution:

Care must be taken when removing and replacing the KingPin to prevent damage to the King Pin Bushings. When the Pin is properly aligned, it should slide easily in through the Bushing. DO NOT align the holes by driving the Pin with a Hammer this will destroy the Bushings.

NEVER check Hole alignment with your Fingers at any time, this would be very dangerous to check alignment on anything that might possibly slip, with your fingers in it you could be injured. ONLY CHECK alignment of Holes with your EyeSight.

Tools Required (Recommended):

1. Combination End Wrench, (1 - ea. 1/2" and 2 - ea. 3/4")
2. Pry Bar, Flat End
3. Hammer, (2 # approx.)
4. Over Head Hoist
5. Floor Jack, (1 Ton or Larger)
6. Support Stand, (Large enough to Support Boom)

Procedures:

1. Clean all components of Boom and Tractor, Remove all Dirt and any other material that may contaminate components as being dis-asembled or when dis-assembled

2. Move Tractor to Level and Firm Ground, Concrete Floor is Best.

3. Swing the Boom to the Side of the Tractor; Extend Boom out till fully extended.

4. With head still attached to Boom (Head helps to stabilize Boom laterally) sit Boom Down till Head is flat on the floor. Make Sure to relieve all pressure from Cylinders.

5. Fully apply the Park Brake on Tractor.

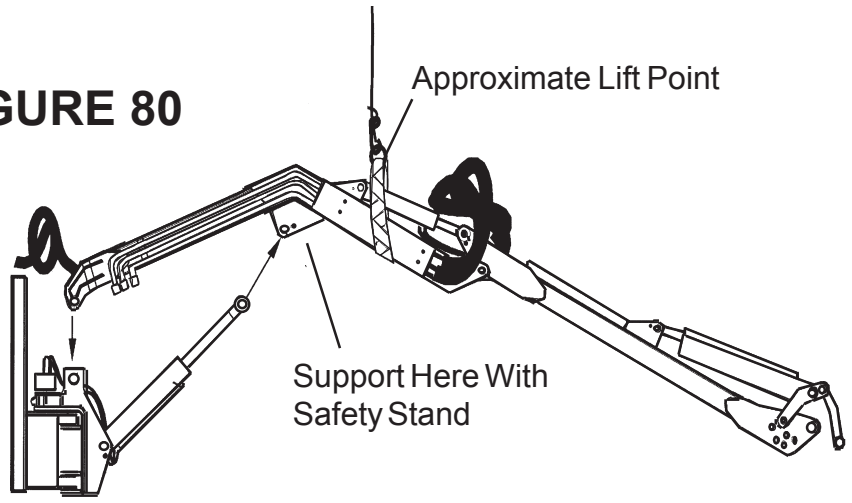
6. Place all Gears in Tractor in the Neutral Position.

7. Shut Off Tractor, remove Key and disable Tractor so it cannot be started till you are ready to have it started.

8. Support the Boom with a suitable Hoist, Attach Hoist as shown in Figure 80.

9. Put Support Stand under Boom for safety support before beginning any removal of parts. Keep This Safety Stand under Boom at all times.

FIGURE 80



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KING PIN - REPLACEMENT

King Pin Replacement Procedure:

Procedures: (Continued)

10. Make Sure that all pressure has been released from Hydraulic Cylinders before disconnecting any Hoses or removing any Pins.

11. Remove Top retaining Pin from the Lift Cylinder (See Figure 80). Once Cylinder has dropped down at top from Pin remove Bottom Cylinder Pin to Move Cylinder Out of way, If dis-connecting any hoses or Fittings always clean around them first. Plug all hoses and Fittings to keep clean.

12. Using the Hoist apply enough Pressure to support Boom, Set Safety Support under Boom. Remove the Boom Pivot Pin (See Figure 80) and lift Boom up above Turning Arm. Readjust Your Safety Support Stand under Boom till there is no space between them, Leave Hoist connected to Boom for Support.

13. Remove the Swing Cylinder Pin on the Rod End, Push Cylinder Back out of way. (Figure 81)

14. Support Turning Arm with another Hoist or suitable Hydraulic Jack.

15. Remove the retaining Bolt and Nut located at the Bottom of kingpin (See Figure 81).

16. Remove the Retaining Snap Ring for kingpin, This Snap Ring is located up inside the Lower boss below kingpin.

17. Remove kingpin by moving Turning Arm back and forth to alleviate binding, Pin Should Slide out through Bottom, If it does not make sure turning arm is supported so as not to be in bind, Also on the bottom of the kingpin there is a threaded hole which allows you to screw a long bolt into it to aid in removing pin. Use Jack or Hoist to set Turning Arm out of way.

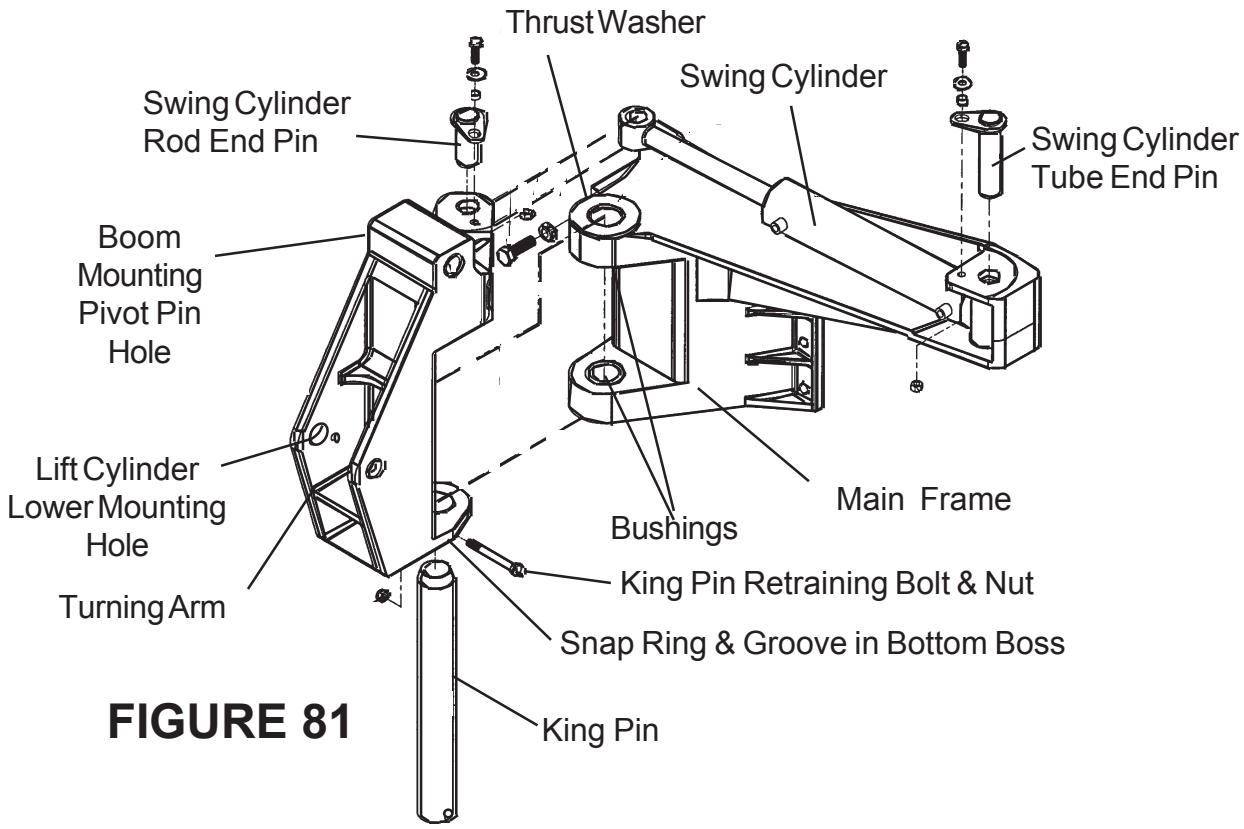

FIGURE 81

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KING PIN - REPLACEMENT

18. Thrust Washer, Be sure to remove the Thrust Washer on top of Upper Pivot Bushing, This washer should be replaced when making these repairs.

19. There are Bushings in the Boom Pivot Pin Holes, The Cylinder Pin Holes and in the Kingpin Pivot holes, (See Figure 81)

20. Kingpin Bushing Removal, The Old Bushing will need to be driven out, this must be done with a suitable Bushing Driver (Alamo Industrial Bushing Driver # 02972281) shown in Figure 82. Care must be taken when doing this to avoid damage to the Bushings and Bosses that Bushings are in. If old bushing had any kind of adhesive applied when it was installed, it will have to possibly be peeled out and hole cleaned up before new bushing can be installed.

21. Cylinder Pin & Boom Bushing Removal, The Old Bushing will need to be driven out, this must be done with a suitable Bushing Driver (Alamo Industrial Bushing Driver # 02972282) shown in Figure 82. Care must be taken when doing this to avoid damage to the Bushings and Bosses that Bushings are in.

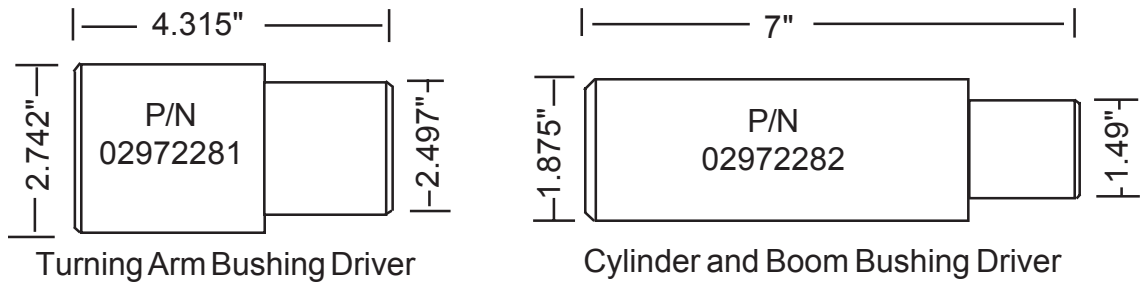

FIGURE 82

22. Kingpin Bushing Replacement, The New Bushing will need to be driven in, this must be done with a suitable Bushing Driver (Alamo Industrial Bushing Driver # 02972281) shown in Figure 82. Care must be taken when doing this to avoid damage to the Bushings and Bosses that Bushings are in. The Bushings should be installed so that the Top Bushing is Flush with the Bottom of the Frame Bore and The Bottom Bushing is Flush with the Top of the frame Bore as Shown in Figure 83. Note: some people use an adhesive (Locktite) on exterior of Bushing, this will not harm anything, but if used bushing must be installed before it dries.

23. Cylinder Pin & Boom Bushing Replacement, The New Bushing will need to be driven in, this must be done with a suitable Bushing Driver (Alamo Industrial Bushing Driver # 02972282) shown in Figure 82. Care must be taken when doing this to avoid damage to the Bushings and Bosses that Bushings are in. The Boom Pivot Bushing should be driven in till the end no longer protrude past Hole

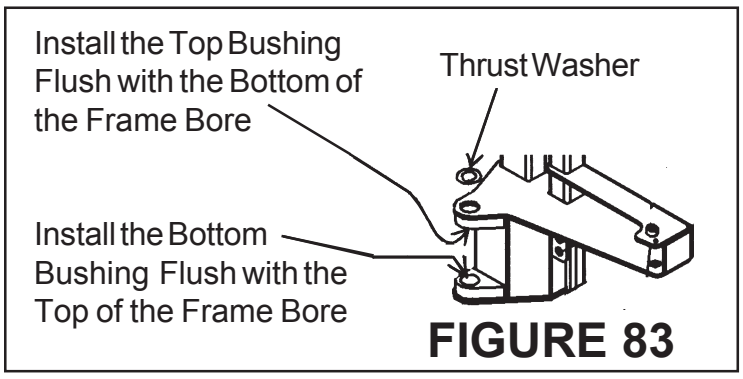
Install the Top Bushing Flush with the Bottom of the Frame Bore
Thrust Washer
Install the Bottom Bushing Flush with the Top of the Frame Bore

FIGURE 83

NOTE: Inspect the Fit between the Bushings and the Frame Bore. The Fit should be a Press Fit. If any looseness between the Bushing and frame is Observed, Or if the Frame bores are out of round, further repairs may be necessary. Contact Alamo Industrial Customer Service dept.

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KING PIN - REPLACEMENT

24. Install Turning Arm, Put Turning Arm back on Mainframe using Hoist or suitable Jack to support and align Turning Arm (DO NOT USE Fingers to align Holes), Make sure Thrust Washer is on top between Turning Arm and Top Bore of Frame. (See Figure 84)

25. Install Kingpin by moving Turning Arm back and forth to alleviate binding, This can be done with a jack or hoist. Blocks can be used to support Turning Arm to help with alignment, there a numerous ways to align Turning Arm. Pin should slide up through from Bottom, If it does not make sure Turning Arm is supported so as not to be in bind, When Pin is installed on the bottom of the Kingpin there is a threaded hole which allows you to screw a long bolt into it to aid in moving pin. Insert the Retaining Bolt into Hole (See Figure 84), This Bolt will hold Pin in, Next Install the Snap Ring into lower Frame Bore up under Kingpin, This Snap Ring Holds Kingpin In the event the retaining Bolt Should Break.

26. Replace Boom, Move Boom back into position with Hoist (Bushings should have already been Replaced, If not see Steps 21 and 23), Lower Boom down over to Turning Arm aligning Holes in Boom with Hole in top of Turning Arm. Align using Hoist, Pin should slide through without a great amount of effort, Install Retaining Nut and Lock on Pin.

27. Replace Swing Cylinder Pin in Rod End and Tube End of Hydraulic Cylinder, Install retaining Bolts.

28. Reconnect Lift Cylinder, Lower Pin (if it was removed) and Top Pin (Rod End), Also reconnect any Hoses that were removed.

29. If Oil loss refill with Oil, Run and Test for operation, Note: if hoses were disconnected and there was Oil loss Unit may have Air in it and may have to be worked out, this can normally be done by cycling Cylinders in and Out.

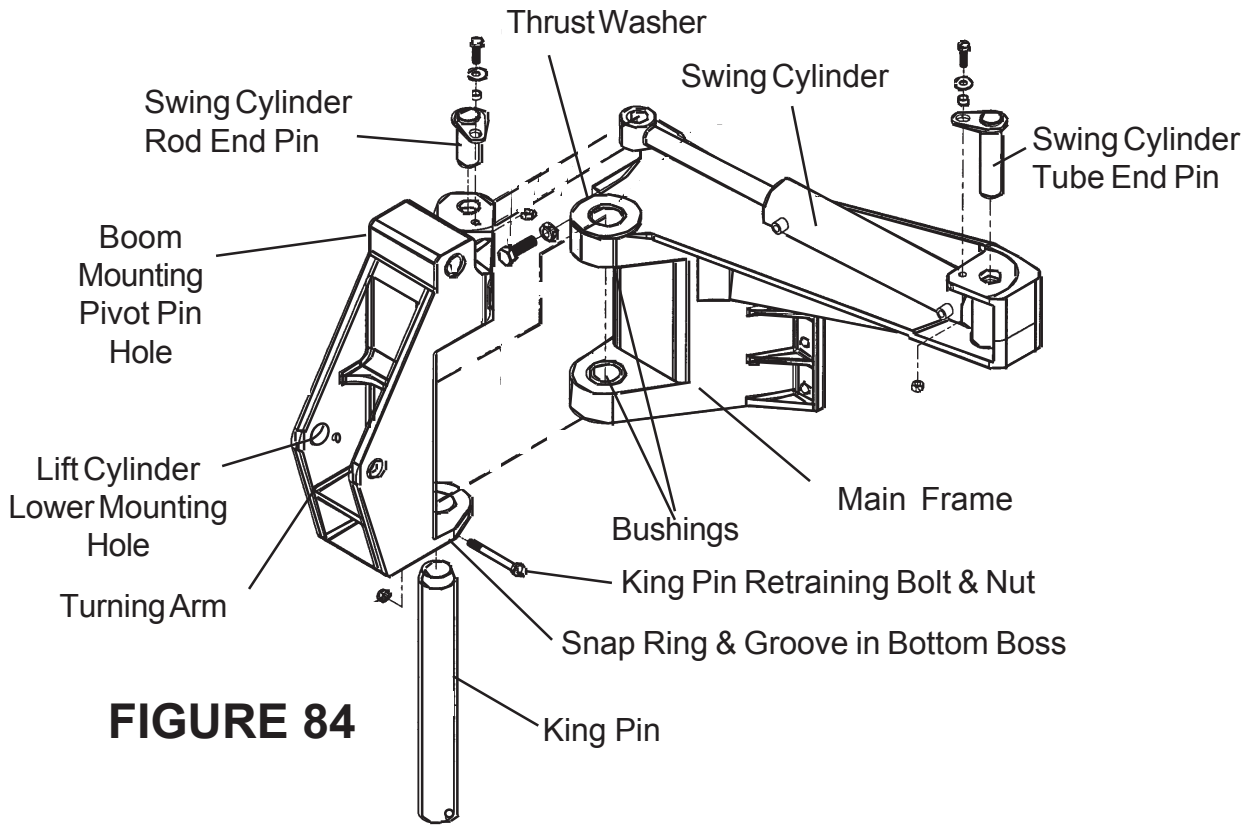

FIGURE 84

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NOTES

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Spindle Repair Section (Rotary Head Only)

Procedures: Remove Blade Bar

1. Clean all components of Boom and Head, Remove all Dirt and any other material that may contaminate components as being dis-assembled or after it has been disassembled.
2. Move Tractor to Level and Firm Ground, Concrete Floor is Best.
3. Swing the Boom to the Side of the Tractor; Extend Boom out till fully extended. Stand Head Up so Blade Bar is facing out away from Tractor in the folded up position.
4. Fully apply the Park Brake on Tractor.
5. Place all Gears in Tractor in the Neutral Position.
6. Shut Off Tractor, remove Key and disable Tractor so it cannot be started till you are ready to have it started.
7. This procedure can be done with head connected to Boom or with it removed, But if removed you will have to lift Head to remove Blade Carrier Assembly.
8. Remove Blade Bar Assembly, Use Caution the Blade Bar is very heavy Do Not remove the retaining bolts till it is secure to where it will not fall. An easy way to support Blade Bar when removing it is to only remove 2 of the 4 retaining bolts. Get 2 long bolts with same size and threads but longer than what was removed, cut the heads off of these 2 longer bolts and screw them in where you removed the 2 retaining bolts. This will support Blade carrier while you remove the other 2 bolts, this allows the Blade carrier to slide off. The four Blade Bar Retaining Bolts are Torqued to 400 ft. lbs. and are tight. It may be required to hold Blade Bar when removing them, This can be done by connecting a Chain to Blade Bar and securing it to Deck. Make Note of the length of the four Blade Bar Retaining Bolts in center Blade Bar (See Figure 85), Never put Bolts back in that are longer or Shorter they will damage Spindle Shaft.
9. It will not be required to dis-assemble Blade Bar Carrier Assembly once it has been removed from Spindle. But if you do dis-assemble it the 4 Blade Bar Assembly Bolts, 2 long and 2 short, are torqued to 2000 ft. lbs., Blade Bolts Torque to 400 ft. lbs. These Torque Values are based on Clean, Lubricated and undamaged threads. These Components must be torqued back to these setting when re-assembled.

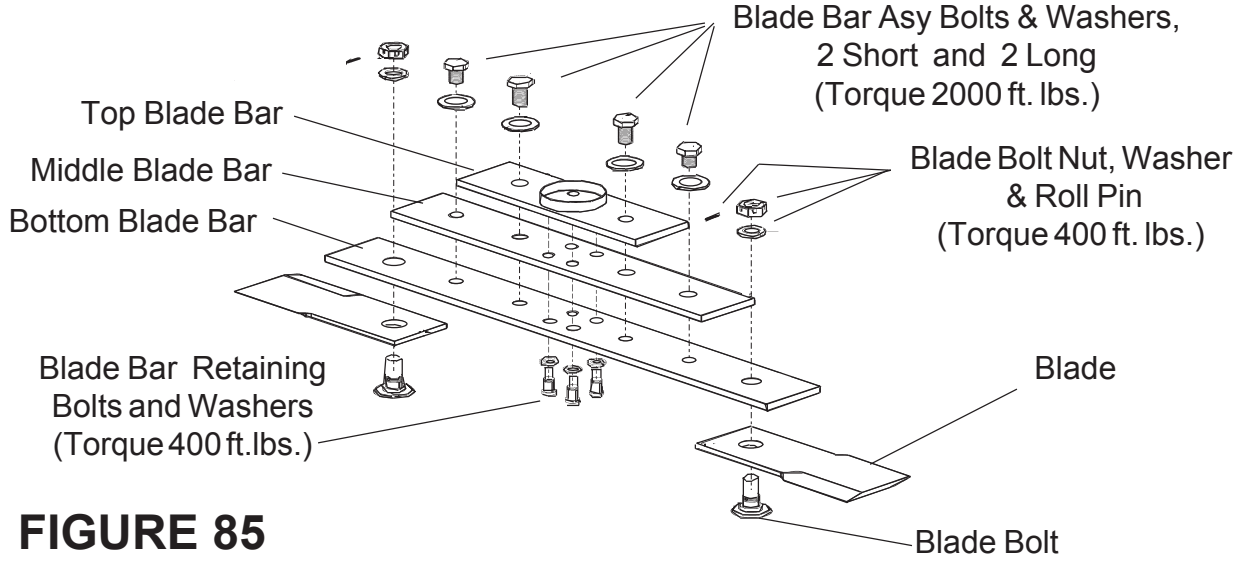

FIGURE 85

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Procedures: Remove Motor and Spindle

1. Remove the Motor Hold Down Tie Rod Nuts on the Top side of motor that are screwed on to Motor Hold Down Tie Rods (See Figure 86), It may be required to hold Ties Rods, This can be done with a Pipe Wrench or other round surface gripping Tool.
2. On Older Models remove the four Bolts in the Center of the Motor Hold Down Plate, On Later Models the four Bolts are in a recess under Hold Down Plate and are not visible till Plate is removed. On the later models these four Bolts will not have to be removed. These four bolts hold Valve Block on top of Motor, After you Lift the Hold down Plate off you will need to secure this Block to the top of Motor with alternate Bolts or it will fall off (on older Models). USE EXTREME CAUTION when removing Valve Block, make sure no foreign material gets into Ports, Also All O-Rings and Back-Up Rings will have to be replaced if this Valve Block is taken loose. See earlier steps about cleaning.
3. Remove the four Bolts that Retain Motor to Spindle, Working Motor side to side lift it away from Spindle. If the Head is standing up on side Oil may run out of Spindle when seal of Gasket is broken, be ready to catch it in a container. It will not be necessary to remove Hoses or connections to motor, you will be able to set motor aside with Hoses connected.
4. Remove Spindle from deck, There are six bolts that hold Spindle down to Deck, remove these Bolts and Nuts to remove Spindle from Deck. You will need someone on bottom side of Deck to hold the Bolts as you take the Nuts off. Spindle will lift off deck from top of Deck.
5. Move Spindle to work Bench; Older Models used a 000 Grease (Thick Oil) that will Drain Slowly, the later models use a Grease that will not drain at all. It is Best to remove grease when Spindle has been dis-assembled.

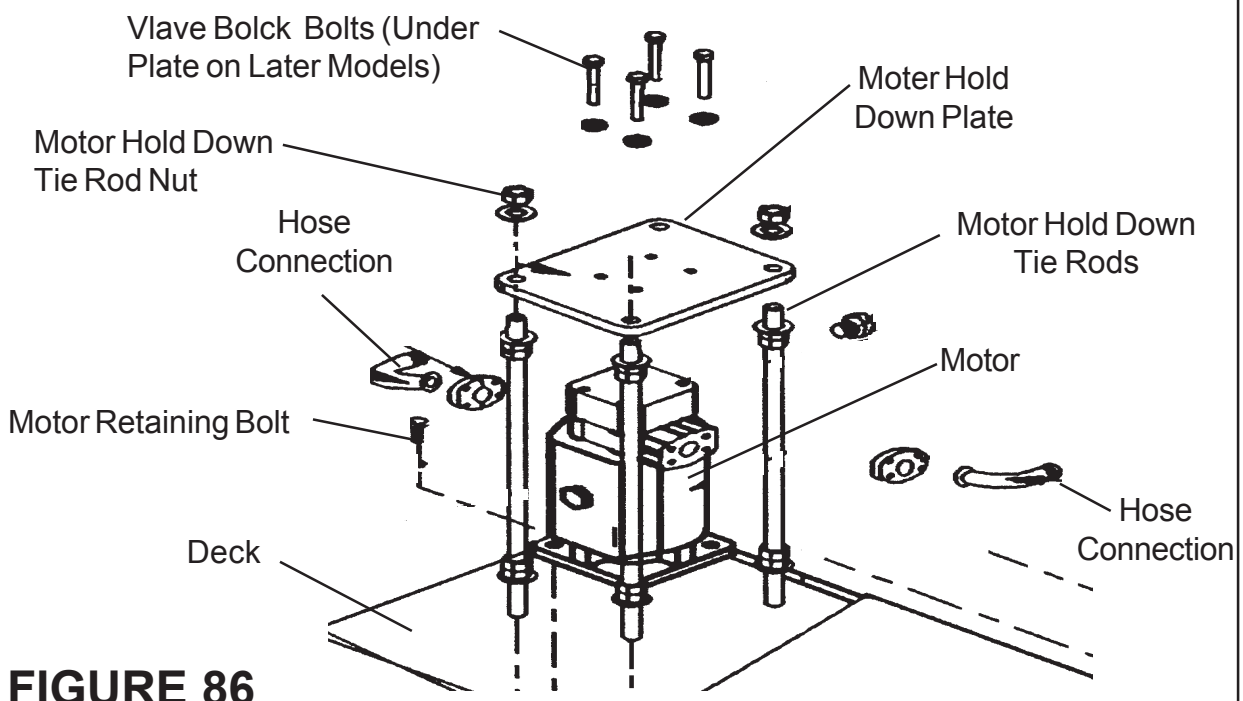

FIGURE 86

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Procedures: Dis-Assemble Spindle

1. Spindle Dis-Assembly, (See Figure 87) The Spindle Shaft is held in with 2 notched round Nuts and a Tabbed Locking Washer, first use small Blunt Chisel to bend tab out away from Notch on Round Nut, Using Tabbed Socket (consult your local Tool supplier) un-screw outer Locking Nut, Lift tabbed Washer off Shaft, un-screw lower Bearing Adjusting Nut. It is best to replace Tabbed Washer with new one.
2. Remove Spindle Shaft, Because of fit of Upper Bearing Cone it will be required to Press Shaft out through bottom of Housing, This should not take a great deal of effort but some. Put a soft Metal Pin (Brass) into top hole of Shaft, (Do Not put one in that will be too big and get stuck). Using Press; push Pin and Shaft Down, It will come out through bottom of Housing.
3. Remove Bearing Cones, Upper Bearing Cone will have stayed in Housing, reach in from to top to remove it, Lower Bearing Cone should have come out and still be on Spindle, For Cleaning and inspecting this Bearing Cone should be removed. You may need a Bearing Puller to remove Lower Bearing Cone from Shaft.
4. Remove Lower Seal from Housing, Discard Old Seal Do Not re-use it only install new Seals.
5. Remove Bearing Cups, Bearing Cups will need to be driven out of Housing with a driver or Pressed out, But they do Need to come out straight, DO NOT DRIVE them out from one side only, keep equal force all the way around them when taking them out or Housing could be damaged.
6. Cleaning Housing, Clean the Housing completely, No Oil or Grease left in it, Completely inspect all areas of Housing, Bearing Cup Bore, Seal Bore, Flanges, Inner and Out surface of Housing for scratches, cracks, Burrs (especially Seal Area for Burrs), Always Dry Parts after Cleaning, Make sure there is no Solvent residue on them that will pollute lubricant, After Cleaning if Parts are not to be assembled right a way put a coat of Oil over ID of Housing and over Gasket area at the top to prevent rust, Un-painted Clean steel will rust very rapidly if left dry of Oil. Keep it covered to keep dust and dirt from collecting on oiled surface.

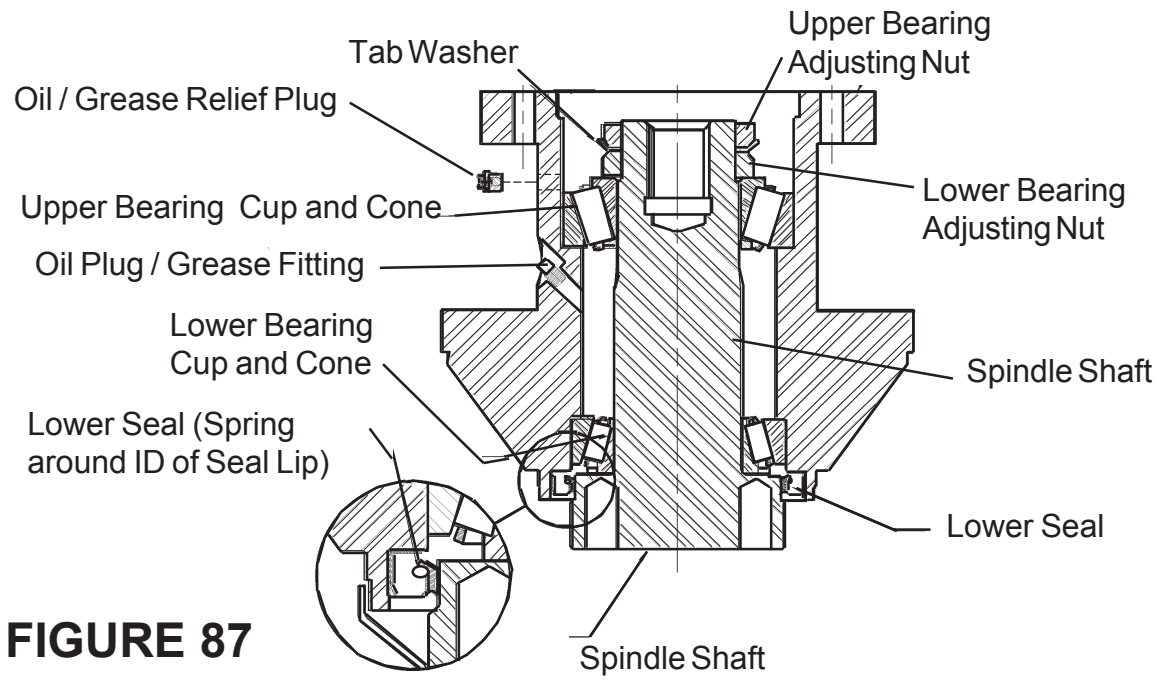
Tab Washer
Upper Bearing Adjusting Nut
Oil / Grease Relief Plug
Upper Bearing Cup and Cone
Lower Bearing Adjusting Nut
Oil Plug / Grease Fitting
Lower Bearing Cup and Cone
Spindle Shaft
Lower Seal (Spring around ID of Seal Lip)
Lower Seal
Spindle Shaft

FIGURE 87

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Procedures: Re-Assemble Spindle

1. Spindle Re-Assembly, (See Figure 88) Make sure Housing is Clean and in Good Shape.
2. Install Bearing Cups, Using a Driver or Press install Upper and Lower Bearing Cups, Make sure they are seated completely into Housing.
3. Install Lower Seal, Inspect Lower Seal area one more time, Make sure there are no burrs around surface, Install lower Seal Using a Driver (consult your local Tool supplier), After installed coat ID of Seal with light coat of Grease.
4. Install Lower Bearing Cone, Inspect Spindle Shaft Condition. Lower Bearing Cone is installed on Spindle Shaft and pressed down till seated on bottom lip on Shaft. Be careful pressing Bearing on, do not damage Bearing. Coat lower Bearing with light coat of Grease.
5. Install Spindle Shaft, Put light coat of Grease on Seal area of Shaft, this will help Shaft go into Seal. Insert Spindle Shaft with lower Bearing Cone installed on it into Spindle Housing from the Bottom, Use Caution when lower part of Shaft reaches lower Seal. work shaft into seal carefully.
6. Install Upper Bearing Cone, Support Spindle Shaft from Bottom and Press (New type is press on and Older type pushed on) Upper Bearing Cone on to Spindle Shaft, Don't press on Bearing Rollers or Cage as this will damage Bearing. It is installed till it is seated into Bearing Cup, Remember to keep Spindle Shaft supported at bottom.
7. Install lower Bearing Adjusting Nut with chamfer up, Tighten Nut till it contacts Bearing Cone, But do not torque at this time. Clamp Spindle to Bench (or Vise) so that Spindle Shaft can rotate. Tighten till it takes 25 in. lbs. to rotate Spindle Shaft, Tap Shaft with a Hammer to make sure Bearings seat straight and recheck Rolling Torque (must be be 25 in. lbs. of rolling Torque).
8. Install Tabbed Washer on to Spindle, Inner tab in slot and Outer tabs facing up.
9. Before Installing Top Nut with chamfer on Nut facing down, Make sure Shaft is locked (Clamped) so it will not Turn in Spindle Housing, Torque this top Nut to 100 ft lbs. Bend the Tab of the Locking Washer to fit into one of the Grooves on top nut. Recheck Rolling Torque of Shaft, it should be 25 in lbs. Rolling Torque.
10. Install Grease Plug in bottom hole and Grease Relief Plug in the upper hole. Note: When grease is cold it could force bottom Seal out of Housing. Let grease warm before filling begins. Excessive Pressure of Air Grease Gun could force Seal out, Use low Pressure.

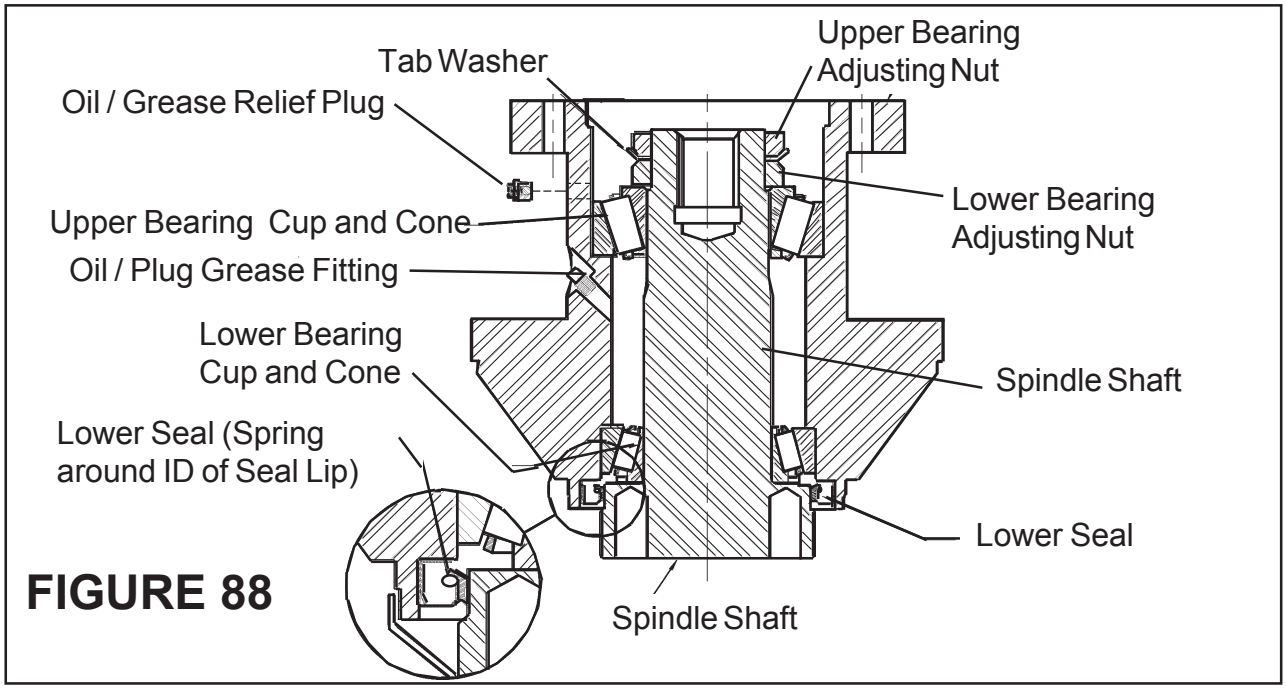
Tab Washer
Upper Bearing Adjusting Nut
Oil / Grease Relief Plug
Lower Bearing Adjusting Nut
Upper Bearing Cup and Cone
Oil / Plug Grease Fitting
Lower Bearing Cup and Cone
Spindle Shaft
Lower Seal (Spring around ID of Seal Lip)
Lower Seal
Spindle Shaft

FIGURE 88

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SPINDLE - INSTALLATION

Procedures: Install Spindle, Motor and Blade Carrier

1. Install Spindle on Deck, Slide Spindle into Deck from Top Side, Install Hardened Washers on Bolts then Insert eight 3/4" Retaining Bolts up from Bottom of Deck, Install the eight Locknuts on Bolts. Torque these Bolts in an alternating Pattern to 300 to 320 ft. lbs. DO NOT leave off hardened Flat Washers, Use Lock Nuts only, do not use Lock Washers,
2. Install Spindle Housing Gasket, Install Spindle Gasket on top of Spindle. Make sure old Gasket was removed and not stuck to Bottom of Motor.
3. Install Motor onto Spindle Housing, Set Motor down onto Spindle making sure Motor sets down flat and is fully seated against Spindle Housing. Make sure Motor is installed correctly, Look at the four Bolts that hold the Valve Body on, Notice two bolts are 2-1/2" (center) apart and the other two are 2-1/4" apart; the two that are 2-1/4" apart goes to the front (toward Door), This is important that Motor be installed correctly so Case drain comes out in right place. The Valve body bolts torque 25 to 30 ft lbs. in an alternating pattern. Insert the four 1/2" retaining Bolts that holds Motor to Spindle, Tighten these four Bolts till Motor seats against Spindle Housing, If Motor will not sit Flat against Housing DO NOT force it, Something is wrong, Check everything or you could break Flange off of Motor. torque the four 1/2" bolts 100 to 110 ft. lbs.
4. Fill Spindle with Grease, Make Sure that Spindle Grease Relief Plug is installed, Fill Spindle with Grease, (Older Models had Oil in them, These older models can be filled with Grease). Fill with Grease till it comes out the Relief Plug. When grease is cold, removing Grease relief Plug will help to prevent Seal from blowing out during filling, replace plug after filled with grease. Wipe away excess Grease.
5. Install Motor Plate (Old Style), Note: This Plate has a front and Back and MUST be installed correctly for the four bolts that go down through the Plate to hold the Valve Block to fit, See Figure 91 on next page or read step 3 above. If working on an older model where the Four Bolts for the Valve Block went through the Motor Plate (see Figure 86), remove the temporary Bolts you installed to hold Valve Block on. Install New O-Rings and Back up Rings on Valve Block. Install Motor Plate down over Tie Rods; Install the four Bolts into Motor Plate that goes through Valve Block and tighten them down. DO NOT tighten the Nuts on the Tie Rods yet. Note to convert old style Motor Plate to new style, use a 13/16" Drill Bit and drill out (Recess) the 4 holes to a depth of 5/8" minimum, this will allow plate to sit down over Bolt Heads for Valve Body on top of Motor.
6. Install Motor Plate (New Style), Note: This Plate has a front and Back and MUST be installed correctly for the four bolts that go down through Valve Block to fit into the four recessed holes on the under side of Plate. See Figure 91 on next page or read step 3 above. If working on new Style the four Bolts that retain the Valve Block on top of Motor should not have been removed. Set Motor Plate down over Tie Rod Bolts, Make sure all the Washer are on and Plate is setting square. DO NOT tighten the Nuts on the Tie Rods yet.
7. Tightening Nuts on Ties Rods will require measuring and adjusting the Upper Nuts under Plate, As the Tie Rods were not remove this measurement should not be far off, BUT they MUST be correct, so using the next two pages and drawings as a guide and instructions, Tighten and adjust Plate Retaining Nuts as Shown. If you are installing components new then, The tightening procedure will have to be done from beginning for the Motor Plate and Tie Rods.
8. Install Blade Bar Carrier, As Bar Blade Carrier was only removed and not dis-asembled it should only be a matter of bolting the Assembly on and Torqueing it down? If Bar Blade Carrier was Dis-Assembled it will have to be assembled and components Torqued as specified, See Figure 85 on previous Pages. Blade Bar Assembly Bolts MUST be torqued to 2000 ft. lbs., There are four of these Bolts, 2 long and 2 short, They MUST be torqued BEFORE Blade Bar is bolted to Spindle. The Blade Bolts must be torqued to 400 ft. lbs. and Roll Pin Installed. The Blade Bar Retaining Bolts (Socket Head Bolts) and lock washer must be installed, These will torque to 400 ft. lbs.
9. After Assembly is completed check all steps to be sure they are completed, Test run Head then Stop and recheck all components including Grease Level in Spindle. Spindle temperature can reach 200 F. after running, so do not check the Temperature by touching it.

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SPINDLE - MOTOR PLATE

60" MACHETE HEAD MOTOR PLATE ATTACHMENT

1. Before installing the rods run two nuts on each end of the rods down 2". Place a hardened Flat Washer on each end (See FIGURE 89**)**.

2. Place the straight rods in the holes marked 1 through 4 (See FIG URE 90).

3. Once the rods are in the holes through the Buck Plate align the rods through the holes on the mount plate and place the mount plate on top of the relief block. The valve block bolts on top of the motor is not equally spaced.Make sure the pockets align accordingly. (See FIGURE 91).

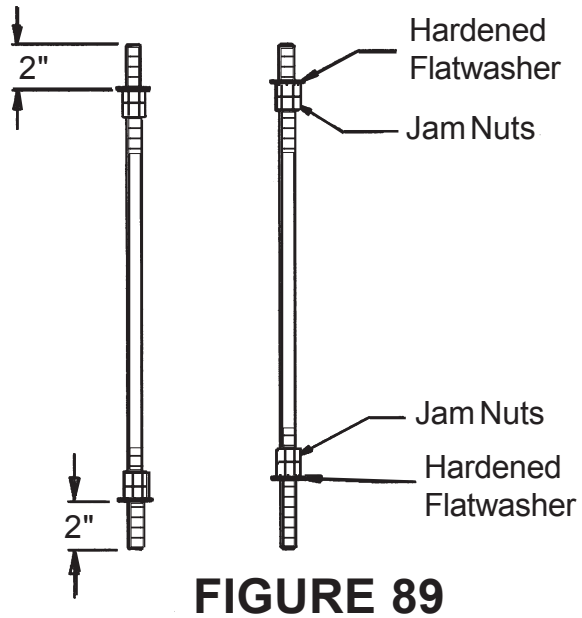

FIGURE 89

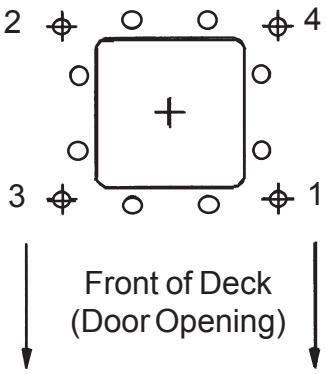

FIGURE 90

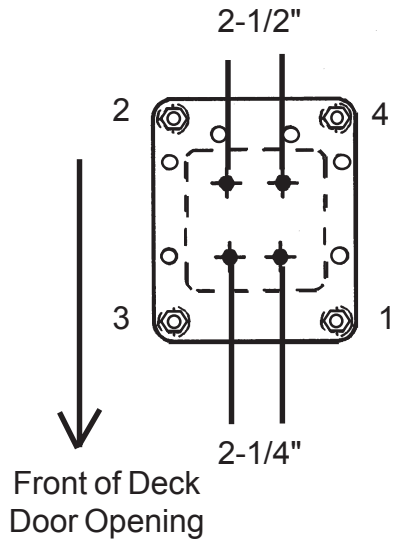

FIGURE 91

4. Place thread locking compound on the threads and install the Hardened Washers and Toplock Nuts on the Rods extending through the bottom of the deck. Torque these rods to 230 Ft-Lbs. (See FIGURE 91).

5. Measure the distance that the rods extend through the top mount plate, this needs to be 7/8" to 15/16". To get this height adjust the two jam nuts by the buck plate. Once the required distance is achieved place thread locking compound on the threads and lock the two nuts together. (See FIGURE 92).

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6. Check to make sure the Flat washer is not contacting the bottom of the mount plate. There should be a 1/4" gap between the Flat Washer and the mount plate, (See FIGURE 93).

7. Place Thread Locking Compound on the threads and install the Hardened Flat Washers and Toplock Nuts. Torque these Nuts to 100 Ft.-Lbs. in three increments and following the positions 1 through 4. Example: torque to 35 ft lbs, 70 ft. lbs. then to 100 ft. lbs. Re-check torque values after reaching the final torque. (See FIGURE 94).

8. Place Thread Locking Compound on the threads and run the Hardened Flat Washers and Jam Nuts up tight against the bottom of the Mount Plate. Lock Jam Nuts together. (See FIGURE 95).

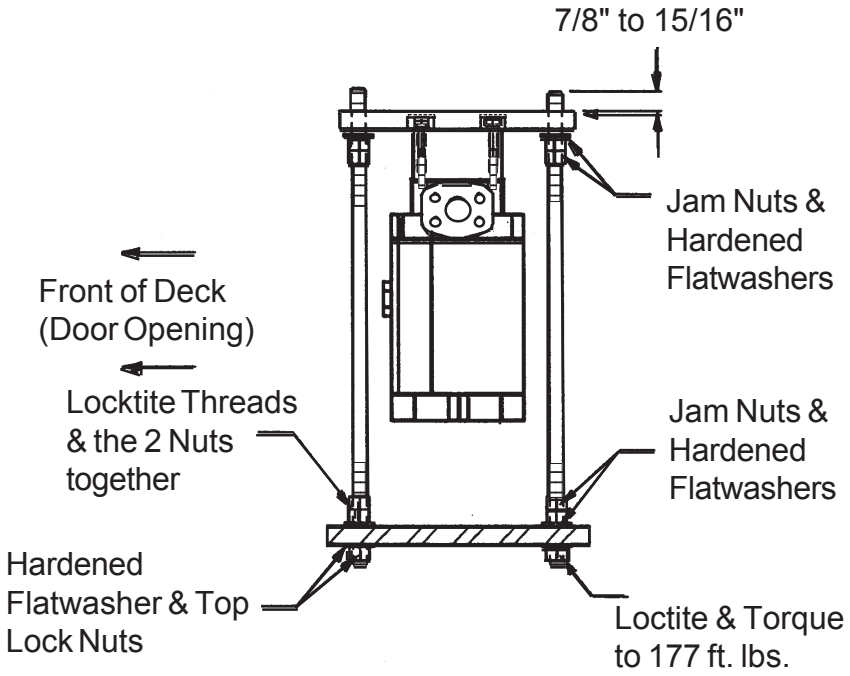
7/8" to 15/16"
Jam Nuts & Hardened Flatwashers
Front of Deck (Door Opening)
Locktite Threads & the 2 Nuts together
Jam Nuts & Hardened Flatwashers
Hardened Flatwasher & Top Lock Nuts
Loctite & Torque to 177 ft. lbs.

FIGURE 92

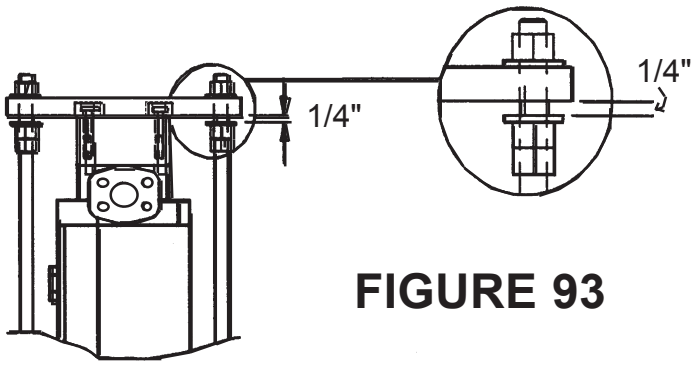

FIGURE 93

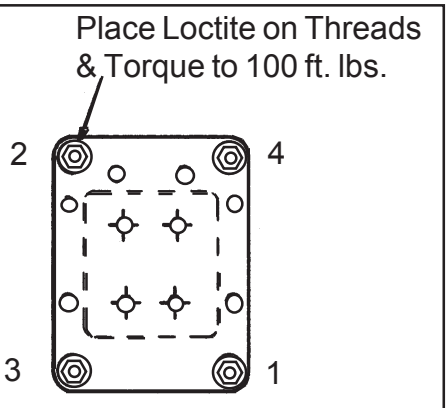

FIGURE 94

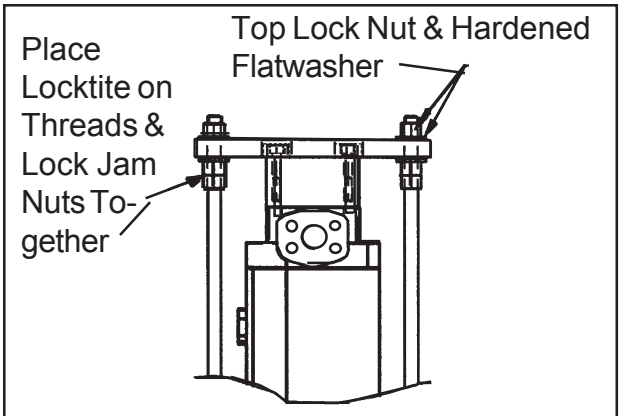

FIGURE 95

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Possible Failure Cause and Solution Section

NOTE;

This Section is written to give a POSSIBLE CAUSE of a problem and the POSSIBLE SOLUTION of a problem, it is also to aid in finding problems and to correct problems. There may be more than one cause to a problem as there may be more than one solution. Inspection and testing by you at the Unit site can diagnose these problems, This section cannot be used as absolute diagnose of a problem as well as not to give the absolute solution. It can only suggest where to check and what to repair.

General:

Cracks in mowing Decks or Booms can be generally attributed to Severe Usage and/or Vibration caused by an imbalance in the rotating parts. It should be remembered that vibrations occur as a result of operation when cutting Heavy Material or hitting stationary object that cause a component to bend, break or lose pieces etc. In some cases it may be the result of a design or application, this is something that will have to be determined through investigation of circumstance.

Simply welding up a Crack will not usually yield a satisfactory repair; simply welding may cause another weak spot during welding process. The condition that caused crack may still be present. It is usually advisable to grind down the weld and add a plate over the weld to span the site of the original crack.

Adding a reinforcing piece (or Extra Brace) may not be as good as it sounds a number of reasons this is not advisable. Because you could be making an area that needs to flex some to relieve stress is being eliminated; the added weight may change the balance of unit or component.

A good suggestion for future reference is to take photos of cracks (Failures) before the repairs are made; this will aid you in future failures to see what happened in the past ones. This is a good idea because the failed area may not always cause the failure, it may be caused by something else and it is sometimes hard to explain what the failure looked like before it was repaired.

Always repaint any area that has been re-welded to prevent rust as well as cosmetic appearances.

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POSSIBLE FAILURE / CAUSE & SOLUTION

SUB - INDEX

Possible Failure	Page
Boom Breaks Back Too Easily	131
Boom Drops When Two Functions Actuated	131
Boom Moves On Its Own (Under Power w/ no function actuated)	135
Cylinder Boom Positioning	132
Cylinder Excessive Drift	133-134
Cylinder Leaks At Fittings	134
Cylinder Leaks At Rod	135
Cylinder Moves On Its Own (Under Power w/ no function actuated)	135-136
Cylinder Moves Wrong Way (Not the function that was actuated)	136
Cylinder Moves intermittent (all functions)	137
Cylinder Moves Spongy or Jerky	138
Cylinder Moves Some Functions (But Not All)	138-139
Cylinder Rod Bent	143
Cylinder Rod Came Out of Cylinder	143-144
Cylinder Won't Move At All (No Power)	140
Cylinder Won't Move Under Load (Low Power)	141-142
Deck Cracks	144
Deck Worn On Underside (Cutting Head Only)	144-145
Hydraulic System Noise (Squeal)	145-146
Hydraulic System Overheating	146-147-148
Motor Flange Breaking	148
Motor Inoperative (Won't Run)	149
Motor Overheating	149-150-151
Motor Shaft Seal Leaking	152
Motor Runs Too Slow (or Slows Down Under Load)	152-153-154
Motor Stops (Stops Under Load)	155-156
Pump Seizure (Pump Locks Up)	156
Pump Wear (Rapid Excessive Wear)	157
Spindle Leaking At Motor	158
Spindle Leaking Around Bottom Seal	158
Spindle Leaking At Relief Vent	159
Spindle Overheating	159
Spindle Shaft Loose or Falls Out	160
Spindle Locks Up (Siezes and Won't Turn)	161
Starter On Tractor Won't Crank	161-162
Tractor Battery Dead or Low (Continous Power Draining)	162

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Boom Breaks Back Too Easily: **Boom is designed to break back if tomuch resistance is meet for safety reason.**

CAUSE: **Work Port Relief for Swing Cylinder Malfunction?**
SOLUTION: Test for Pressure required to Break Back the Boom. If Pressure is lower or higer than Specified, Adjust or Replace Work Port Relief Valve.

CAUSE: **Cutting Head Positioned Too Close To The Ground?**
SOLUTION: This is an Operational Problem, The Operator will be required to adjust the way the unit is being run and raise the Head Up.

CAUSE: **Operator Running Into Too Heavy Material or Traveling Too Fast?**
SOLUTION: This is an Operational Problem, The Operator will be required to adjust the way the unit is being run and Adjust Operating procedures to eliminate this.

CAUSE: **Inadequate Bracing?**
SOLUTION: This is a difficult subject, It is recommended that you consult with the factory before making modifications of this type, Adding additional pieces may change many components functions, the weight that would be added changes the balance weight ratio. The Hydraulics ability to lift and even lower could be affected. Adding weight is not recommended.

Boom Drops When Two Functions Actuated:

CAUSE: **Low Oil Level in Tractor Hydraulic System?**
SOLUTION: Fill and Bleed all Cylinders (Run All Cylinders through thier Cycle), Then fill Tractor Hydraulic Oil to Proper Level, Run Cylinders through thier Cycle again and recheck Hydraulic Sump Oil Level again. If the Cylinders are not Filled then Oil Level brought to Specs the Oil Level could be low during operation causing damage to Tractor Hydraulic System.

CAUSE: **Too Rapid Drop Of Boom?** (Too Rapid Drop in Cylinder)
SOLUTION: Restrictors damaged or removed, Check restrictors if they have them, Make sure correct size Hoses are installed to cylinders. Repair or Replace as needed.

CAUSE: **Defective or Damaged Joy Stick Controller?**
SOLUTION: There are very few replaceable Parts in Joy Stick Controller, See the Repair Section for Testing and repairing the Joystick. DO NOT Replace Joystick till all Test have been performed to pin down the problem area. There are a number of tests to locate problem area that can be used, these are listed through out sections of the repair Manual as well as some listed in the Operators Manual.

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Cylinder Boom Positioning:

Cyl. Continue to move after Joy Stick released.

Boom Moves on its Own (Electronic Joystick). Joystick does Not return to Neutral.

CAUSE: **Defective or Damaged Joy Stick Controller?**

SOLUTION: There are very few replaceable Parts in Joy Stick Controller, See the Repair Section for Testing and repairing the Joystick. DO NOT Replace Joystick till all Test have been performed to pin down the problem area. There are a number of test to locate problem area that can be used, these are listed through out sections of the repair Manual as well as some listed in the Operators Manual.

CAUSE: **Oil Contaminated?**

SOLUTION: If the Filters are Not Maintained properly on the Tractor Hydraulic System, Fine contaminates can get into the Solenoid valves, this prevents them from seating Properly. This can result in Boom Circuits moving without input from the Joystick Controller. When Filters get full, It causes the Bypass valve on the Filter to Open and allow unfiltered Oil to go throughout the System. Once this is allowed to happen even though the Filters are later changed, it is no guarantee that the malfunction will not re-occur because the contamination could be any where in the system waiting to break free and travel on through the system. Later Models (Machete) had an add on filter added which has a lower Micron Rating than Tractor Filter, This was added to keep Contamination from Tractor System from going through the Boom System, Both Tractor and add on Boom Filter will have to be changed an a regular maintance schedule, See Operators manual.

Control Valve Spool or Spools Sticking

CAUSE: **Control Valve Bolted to Mounting Plate Incorrectly?**

SOLUTION: Loosen bolts and re-tighten 1 turn at a time using a criss-cross pattern. The Valve Body can be placed in a bind if the mounting bolts are tightened un-evenly. This can cause the Spool to stick in the bore or cause the Valve to leak internaly.

CAUSE: **Contamination in Valve Spool?**

SOLUTION: Find Contamination source and correct it, Clean Valve, Change Filters, Replace Oil (if required to remove contamination), Re-Assemble and Test.

CAUSE: **Faulty Valve Spool or Section?**

SOLUTION: Replace Valve Section, If the valve Section is defective, The Malfunction will most likely occur immediately after being placed in service. If the Unit has been operating for sometime, the problem is most likely to be a failure not a defective part there fore more checking maybe needed to determine why the Valve Spool failed.

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Cylinder Excessive Drift:

NOTE: All Cylinder Hydraulic Systems have some amount of drift or leakage in the system. All parts have tolerances and all parts Must have clearance in order to function. Clearance necessary to allow the part to function also results in some internal leakage. Cylinder Drift can also be refered to as "Leak Down" or "Settling", In most cases, the cause of Cylinder Drift will be found in the Cylinder, Valve (s) or Lines. Components have a different leakage rate. Reducing the amount of drift also has its drawbacks. "Tight" components are very sensitive to contamination, Seizure due to high operating temperatures, Seizure due to contamination. Valves have a tight clearance, restrictors have small openings. Leaking External Lines cause Cylinder Drift but this is the easiest problem to correct as it is the easiest type to find. There fore most causes listed below will deal with Internal Leakage. See "Cylinder Drift Rate Chart" in Specification Section of Product Repair Manual to determine if drift rate is excessive. See Cylinders Leak Section for Cylinder leak Problems.

CAUSE: **Cylinder Pistons Seals Bypassing?** Dual Function Cylinders have 2 lines and have pressure both ends, Single Function Cylinders have 1 line and pressure on one end and Vent Plug on other, Piston bypass in Single Action Cylinders it will not require this test, If they leak the Oil will leak out of Vent Plug.

SOLUTION: Raise load and support it safely. Drain Pressure off Line after Load is supported and before removing any lines. Drain Pressure can be done with Tractor "Off" and open valve to lower Load. Remove and solidly plug lines to the Cylinder. Remove Load Support (Hoist will be reqiured), Document the time it takes for the load to drift down. (See Cylinder Drift Chart) If the Piston Seal is cause of excessive Drift down this will tell you. Reseal or Repair Cylinders as required. Note Piston Seal bypass can be caused by damaged Seals, oversized or worn Cylinder Bores. Some Cylinders don't function through out the intire length of their stroke, So the oversize wear could only be in part of the bore, When checking Bore size it is recommended to check entire length of Bore if the length of stroke is not known.

CAUSE: **Work Port Relief Valves Not Seating Properly?**

SOLUTION: Test Cylinders for Bypassing as above. If OK, Leakage must be occurring in the Control Valve Spool or Work Port Reliefs (if Equipped). Suspend the Load with the Cylinders and place Valve Lever in "Hold" (Neutral / Centered) position. Use a "Stethoscope" Tool (or equivelant), Listen to the Valve Body next to the Work Port that is suspect. The Oil will be making a shrill whistling sound as it leaks past the Work Port Poppet. If Leakage is evident, Lower the Load and inspect to Work Port Relief Valve, replace if needed.

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Cylinder Excessive Drift: (Continued)

CAUSE: **Leakage Past Control Valve Spool?**

SOLUTION: If excessive Cylinder Drift is confirmed and the Cylinder and Work Port Relief Valves have been eliminated, The possibility is the Control Valve Spool itself. If clearance between the Control valve Spool and Body are causing the drift, the Only Solution is to replace the Valve Section. Keep in mind that the cause for excess clearance must be found and corrected. Frequently the cause is pre-mature wear from abrasive material (Contamination) in the Oil. If this is not corrected failure will re-occur.

CAUSE: **Abrasive Contamination In Oil?**

SOLUTION: Abrasive Contaminants (Dirt, Iron Particles, Clutch Disc Material etc.) in the Oil Sump / System is a major contributor to all of the above internal leakage problems. It is especially likely if the Positioning Hydraulics are using Oil from the Tractor Hydraulic System. If the Tractor Hydraulic System is not properly maintained, Materials from Gears, Clutch Disc and Etc. can enter the Control Valve and Cylinders causing excessive Pre-mature Wear. If Abrasive material Wear is found the complete system Should be flushed and cleaned. On Some Later Models an additional Filter System has been added as additional Filtering of Tractor Hydraulic Oil. But even this add on Filter, if not maintained, will run through the Filter Bypass and contaminate System. KEEP FILTERS CLEAN and/or Replace on a good Maintenance Schedule.

CAUSE: **Electrical Short Circuit?**

SOLUTION: Electrical short causing controls to emit electrical current even though controller is in neutral position. Check all wire connections and try to determine where electrical short is, Repair or replace as needed. Usually this type of problem will allow drift to be rapid unless Short is through Joystick controller, There should be no electrical current when Valve and Joystick are in centered (neutral) position

Cylinder Leaks At Fittings:

CAUSE: **Loose or Wrong Fittings?**

SOLUTION: Make sure correct Fittings are installed and are torque to correct specification. Boss Fittings may have damaged O-Ring, Check and repair as required.

CAUSE: **Port Cracked at Fitting?**

SOLUTION: Repair or Replace Cylinder and/or Fitting. This type failure is more common on Cylinders with Pipe Fittings than the ones with O-Ring Boss Fittings. The reason is because the Pipe Thread is tapered and can be over tightened and the tapered thread acts as a wedge. Don't over tighten any fittings, Don't use Teflon tape at all, if using a Semi Liquid Pipe Thread Sealer Don't put excessive amount on fitting and Never put sealer into ID of Port, It will get into system and contaminate it.

CAUSE: **Deformed or Damaged Fitting?** (JIC)

SOLUTION: Replace damaged Fittings and/or Hose, Over tightening of JIC Fittings can deform the Flares on the Fitting and create leaks. See Torque Specification for proper Torque Values.

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Cylinder Leaks Around Rod:

CAUSE: **Faulty Seals On Cylinder Gland?**
SOLUTION: Dis-Assemble and Re-Seal Gland. Seals can be damaged by foreign objects, or worn by abrasive material such as Dirt getting into Seal and/or Rod. Seals can also be damaged during Assembly and this type of damage will almost always show up shortly after being put in service.

CAUSE: **Damage To Cylinder Rod?**
SOLUTION: Determine the cause of the Damage, Dent, Scratch, Rust and/or something stuck to Rod. The Damage and cause should always be identified and corrected before any repairs are made, Repairing the failure and leaving the cause will result in more failure. In Some cases a Cylinder Rod can be cleaned up with CROCUS CLOTH (a very fine abrasive material), DO NOT USE anything more abrasive than crocus cloth. A major problem for cylinders is storage when unit is not being used for a while, The Rods are a chrome alloy but if subjected to moisture long enough they will rust, This is not a problem when being operated as they are be cleaned with every in and out stroke. If Unit is going to be stored for an extended time you can coat Rods (Exposed Part) with Oil or Grease to protect them, But If you do this it must be cleaned off before running to remove the Dust that will have collected on rod from Oil and grease.

CAUSE: **Cylinder Rod Bent?**
SOLUTION: Determine and correct cause of bent Rod, Replace Rod and Re-Seal Cylinder.

Cylinder Moves On Its Own: (Under Power)

CAUSE: **Control Valve Spool Stuck?**
SOLUTION: Locate stuck Spool, repair or replace Spool, Determine why Spool is stuck, Debris, Foreign Objects, Contamination, Broken Spool Components and etc. If just the Spool is replaced and the reason it failed is not corrected, it will fail again.

CAUSE: **Return Spring Broken in Control Valve?**
SOLUTION: Repair or Replace Spring, Determine why it broke.

CAUSE: **Binding of Control Cables or Linkage?** (Remote Cable Control Models)
SOLUTION: Determine cause of Cable Binding or Sticking, repair or replace as required. Sometimes it may be the Linkage sticking or binding and not the Cable, It may be required to disconnect Cables from Linkage to determine which is sticking, If it is the Linkage repair as needed. Cables may stick because of internal abrasion inside calve Housing, Some times this damage is not visible.

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Cylinder Moves On Its Own: Under power (Continued)

CAUSE: **Controller Not Returning to Center?** (Electronic Joystick Control Models)
SOLUTION: Test Joy Stick Controller as shown in Repair Manual, Repair or Replace as needed. Note: Do Not replace Joystick till Test have been performed to eleminate other possible failures, Other Malfunctions can appear like Joystick Failures.

CAUSE: **2 Way Radio RF Interference?** (Models will Electronic Controllers)
SOLUTION: Radio Frequency interference is a common problem with all electronic controllers in all equipment and vehicles. Normally keying the microphone of the radio will result in some unwanted or unexpected operation. In the case of a boom mower on of the boom functions may slowly begin to move.
The resolution of this problem requires that power to the controller be disconnected when operating the radio. To accomplish this, simply switch off the power switch on the controller box prior to using the radio.
This may affect Tractors that are equipped with two way radios and when using radio to send, When Radio Receives there should be no interference.

Cylinder Moves Wrong Way:

(Opposite of direction it should per Control Movement)

CAUSE: **Hoses Routed incorrectly?** (On New or Repaired Units)
SOLUTION: Route hoses per Hose Diagram in Parts Manual.

CAUSE: **Incorrect Valve Operation Plate?** (On New or Repaired Units)
SOLUTION: Replace with correct Plate.

CAUSE: **Wire Harness improperly connected?** (On New or Repaired Units with Joystick)
SOLUTION: Change connectors to other solenoid valve on Same Circuit and test. Applies to Old Apitech valve Models (Ten Connector Wiring harness 5 on each side of Valve,)

CAUSE: **Confusion On Direction Travel of Joystick or Switch Application ?**
SOLUTION: The Function of Joystick is specific to type or combinations of movement that is made to perform that function, If the system was not connected correctly when first assembled the the movements may not match what is expected. See Operators Manual, Parts Manual or Repair Manuaul for what action or combination of actions should operate what function.

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Cylinder Moves Intermittent: (All Functions)

CAUSE: **Obvious Causes Check First?** (Check These First)
SOLUTION: Perform all Operational checks, Tank Oil Level , Pump Operation, Control Valve Circuit (Electrical Supply & Hyd Supply), All Circuits affected or only some Circuits. If All Circuits will not work the Problem is most likely up-stream of the control Valve or an electrical Problem (Models with Joystick Controller). The Following Causes are based on Only some circuits being affected, Not all Circuits.

CAUSE: **Load Sense Signal Not Reaching The Tractor Pump Control?**
SOLUTION: Remove, Inspect and clean Signal Lines from Control Valve to Priority Valve. Check all orfices to make sure they are clear. Note: it is not unusual for the debris to drain out of system with the Oil when the pressure is released or the lines are removed. Everything can appear clear then be pushed back in when pressure is applied or it may never return, this can be a difficult malfunction to find as well as correct. This means even though it was checked once it does not mean the problem is not there.

CAUSE: **Low Oil Level In Tractor ?**
SOLUTION: Fill to Proper Level with recommended Oil. See Specification Chart for recommended Oil type.

CAUSE: **No Voltage to Joystick Controller?**
SOLUTION: Check for Voltage to Controller. repair or replace as required, Wiring, Fuses, Switches, etc.

CAUSE: **Faulty Joystick Controller ?**
SOLUTION: Check for Voltage output from Controller. With power to Controller and Joystick function actuated, Check for Voltage at Harness end of Solenoid Valve Connector for that function that is actuated. If there is no Output Voltage from Controller, check Controller End of Harness, If still no Voltage Repair or Replace Controller as needed. If Voltage at Controller then check Harness and Repair or Replace as needed. (see pages 56 and 57 trouble Shooting / Testing)

CAUSE: **Faulty Tractor Hydraulic System ?**
SOLUTION: Perform Hydraulic ? Electrical isolation Test. If Tractor System is at Fault, Trouble Shoot and Repair Tractor per Tractor Manufactures Guidelines.

CAUSE: **No or Low Pilot Pressure?**
SOLUTION: Check Pilot Pressure. Test, Adjust or Replace Pilot Pressure Valve as required

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Cylinder Moves Spongy or Jerky:

CAUSE: **Air in Oil?**
SOLUTION: Run the System for a few minutes. Check for Air in the Oil in the Tank. Air entrained Oil will have a foamy appearance. If Air is present, find the Air Leak and correct it. Air Leak can be in the Suction Line and Oil may not leak out because there may only be Oil in that location when the Pump is sucking it in. With the Tractor Engine "Off" you can find a leak by pressurizing the Tank, This will not take but a few pounds of pressure (3 to 5 PSI or less). Look for leakage in the Suction Lines, Because the Oil Pick-Up is lower than the Oil Level this will force Oil out the leak. Leaks in Hoses and at Fittings can draw Air into System as Oil Flows Past. Systems that have had severe or prolonged Air Entry Problems may have Experienced Pump Damage.

CAUSE: **Air in the Cylinders?**
SOLUTION: Remove Air from Cylinders by Bleeding the System. Operate Cylinders and Hold at maximum stroke for several seconds. Repeat several times to purge Air from Cylinder. Repeat for other Cylinders till condition no longer exist.

CAUSE: **Wrong Type of Oil?**
SOLUTION: Fill to Proper Level with recommended Oil. See Specification Chart for recommended Oil type. If changing Oil in Old type Unit always use most recent recommended Oil Type but do not mix types of Oil.

CAUSE: **Cold Oil?**
SOLUTION: Run Unit at low Speed until Oil warms up. If Oil is to cold and flows slowly it can cause Cavitation, this will damage Pump. DO NOT Operate if Oil is so thick that you have this problem, wait till it warms up or move unit To a Building where Oil can warm up before operating.

CAUSE: **Faulty Pump Drive?**
SOLUTION: Inspect Pump Drive Components for wear and damage, or other reason pump May not run smoothly. If Pump is not smooth then Pressure will not be steady causing surges in pressure.

CAUSE: **Work Port Relief Set Too Low for Application?**
SOLUTION: Install proper work Port Relief. If the Pressure needed to operate the function Can exceed the setting of the valve in certain positions, it will cause the Oil to bypass, causing jerky movement of the function.

Cylinder Moves, Some Functions Work, But Not All:

CAUSE: **Faulty Joystick Controller?**
SOLUTION: Check Output voltage at the harness end connector for the affected Function, (Switch ON, Engine OFF, Joystick Function Actuated). If No Voltage is present, Check Harness, If Harness is OK, Repair or Replace Controller as needed. (See Page 56 and 57)

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Cylinder Moves, Some Functions Work, But Not All:

(Continued)

CAUSE: **Obvious Causes Check First?** (Check These First)

SOLUTION: You may have enough Oil to operate one function but not all because Some Cylinders will require more volume than others will. Perform all Operational checks, Tank Oil Level, Pump Operation, Control Valves Circuit (Electrical Supply and Hydraulic Oil Supply), All Circuits affected or only some Circuits. If All Circuits will not work the Problem is most likely up-stream of the control Valve or an electrical Problem? (Models with Joystick Controller). The Following Causes are based on Only some circuits being affected, Not all Circuits.

CAUSE: **Faulty Solenoid Valve?**

SOLUTION: If Pilot Pressure is present with engine running, Voltage is delivered to the Coil and/or Module, the function operates manually but not Electrically, it is likely that the valve is the Problem. Repair or replace as needed.

CAUSE: **Control Valve Bolted to Mount Plate Incorrectly?**

SOLUTION: Loosen Bolts and retighten 1 turn at a time using a criss cross pattern. The Valve Body can be placed in a bind if the mounting bolts are tightened incorrectly. This can cause the Spool to stick in the Bore or results in Internal Valve Leakage.

CAUSE: **Contamination in the Valve Spool?**

SOLUTION: Clean Valve, Check complete System for contamination, Flush and Clean as required. Reassemble and Test.

CAUSE: **Faulty Valve Spool or Section?**

SOLUTION: Determine what caused Valve Spool to be Faulty, is it a failure or a defect, A Defect usually shows up soon, Failure can be any time. If Defect Repair or Replace as needed, If Failure determine cause of Failure, Repair Failure cause and Repair or replace Spool Section.

CAUSE: **Faulty Control Module?** (electric over hydraulic new style (5 wire) valve only.

SOLUTION: Valve control modules may develop one of two modes of failure:

1. Water damage: In this case condensation will develop in the circuit board cavity of the controller and result in a short. With this mode, the controller will stop working in one or both directions and will very seldom regain function.

2. Thermal Fatigue: This failure will be identified as a module which performs adequately when cold but will stop working in one or both directions as the unit warms up. This is caused by fatigue of the wire strip located inside the module. Identify the signal wire from the joystick attached to the faulty segment of the valve (swing, lift, dipper, etc). Use a phillips screw driver to remove the wire. Remove the wire attached to the module next to the faulty segment and swap the two wires. If the problem moves to the new location, the problem is in the Joystick or harness. If the problem continues in the affected valve segment, replace the module.

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Cylinder Won't Move At All: (No Power)

CAUSE: **Obvious Causes Check First?** (Check These First)
SOLUTION: Perform all Operational checks, Tank Oil Level, Pump Operation, Control Valve Circuit (Electrical Supply & Hydraulic Supply), All Circuits affected or only some Circuits. If All Circuits will not work the Problem is most likely up-stream of the control Valve or an electrical Problem (Models with Joystick Controller). The Following Causes are based on only some circuits being affected, Not all circuits.

CAUSE: **Incorrect Hose Routing?** (Unit has never worked or been repaired)
SOLUTION: Check Hose Routing with Parts Manual and Assembly Guide to make sure Hoses are routed correctly. Move and reconnect Hoses as required.

CAUSE: **Work Port Relief Installed Improperly?** (Unit has never worked or been repaired)
SOLUTION: Determine correct positioning of Work Port Relief's. If relief's are incorrectly installed, Install correctly and Test.

CAUSE: **Work Port Relief Malfunction?**
SOLUTION: Determine if one or both sides are affected. Make sure Work Port Relief's are in proper position, Swap Hoses with another circuit or swap Work Port relief's with another circuit to determine where problem lies. Repair or replace faulty Parts as required.

CAUSE: **Control valve or Remote Control Malfunction?**
SOLUTION: Observe actuation of Valve Spool in relation to Control Lever. Repair any faults.

CAUSE: **Restrictions in System?**
SOLUTION: Look for Kinked, Plugged, Pinched Hoses or Lines. Observe as Cutting Head is moved throughout its range of movement. Do not forget the possibility of foreign objects being lodged in Restrictors, Hoses, Tubes, Fittings and/or Lines

CAUSE: **Piston has come off of Rod?**
SOLUTION: This can be difficult to diagnose, if the Piston comes completely off of Rod it can be pushed to bottom of Barrel below Port, Then Oil just circulates around through Piston with little or no resistance, This makes it appear there is no Pressure or valve is not working. The best way to check would be with a Flowmeter in Cylinder Line. Check, Repair or Replace as required.

CAUSE: **Vent Plug Block or Not Installed?** (Power One Way Cylinders)
SOLUTION: This applies to Cylinders that only Stroke in or Out under pressure, The return Stroke under gravity. Remove Plug, Clean or Replace as needed. If No Vent Plug is there determine if one is needed and install as required. (See Parts / Operators Manual for Vent Plug requirements).

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Cylinder Won't Move Under Load: (Moves Slowly)

CAUSE: **Obvious Causes Check First?** (Check These First)
SOLUTION: Perform all Operational checks, Tank Oil Level, Pump Operation, Control Valve Circuit (Electrical Supply & Hydraulic Supply), All Circuits affected or only some Circuits. If All Circuits will not work the Problem is most likely up-stream of the control Valve or an electrical Problem (Models with Joystick Controller). The Following Causes are based on only some circuits being affected, Not all Circuits.

CAUSE: **Incorrect Hose Routing?** (Unit has never worked or been repaired)
SOLUTION: Check Hose Routing with Parts Manual and Assembly Guide to make sure Hoses Are routed correctly. Move and reconnect Hoses as required.

CAUSE: **Work Port Relief Installed Improperly?** (Unit has never worked or has been repaired or worked on)
SOLUTION: Determine correct positioning of Work Port Relief's. If reliefs are incorrectly installed, Install correctly and Test.

CAUSE: **Work Port Relief Malfunction?**
SOLUTION: Determine if one or both sides are affected. Make sure Work Port Relief's are in proper position, Swap Hoses with another circuit or swap Work Port relief's with another circuit to determine where problem lies. Repair or replace faulty Parts as required.

CAUSE: **Control valve or Remote Control Malfunction?**
SOLUTION: Observe actuation of Valve Spool in relation to Control Lever. Repair any faults.

CAUSE: **Restrictions in System?**
SOLUTION: Check Hoses and Lines for Kinks / Obstructions. Hoses have an inner lining that can turn loose and block a hose. If Assembly or Repair work has been performed, recheck all connections for correct location. Some may not be visible without some dis-assembly. Unplanned restrictions cause increased backpressure, loss of usable power, excess Heating of Oil and failure of Shaft Seals.
Restrictions can sometimes be found by measuring the temperature of the Oil (or fittings) at various points in circuit as heat will usually be higher at the restriction. The restriction should be located at or upstream of the increased temperature point.
Restrictions are sometimes caused by foreign objects that get into the system, This can happen during servicing, maintenance or repairs. It is not uncommon to find bolts, nuts, plastic plugs, paper or rags stuck into system when it was being repaired or assembled then forgotten about.
Restrictions sometimes can be a piece off of a failed component up stream or a Component such as a Hose built wrong.

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Cylinder Won't Move Under Load: (Continued)

CAUSE: **Piston has come off of Rod?**
SOLUTION: This can be difficult to find, If the Piston comes completely off of Rod it can be pushed to bottom of Barrel below Port, Then Oil just circulates through Cylinder with little or no resistance, This makes it appear there is no Pressure or valve isn't working. The best way to check would be with a Flowmeter in Cylinder Line. Check, Repair or Replace as required.

CAUSE: **Restrictor Valve Installed in Wrong Line, Backwards or Plugged?**
SOLUTION: Determine the correct location of installation for Restrictor and make sure it is in correct location. Inspect for being Plugged, Clean or Replace as needed.

CAUSE: **Excessive Internal Leakage in Pump / Motor?**
SOLUTION: Perform Flow and Pressure Test. If results aren't within Specifications, determine the cause of the internal leakage, correct the cause. Replace worn or damaged parts. It is good to replace the Filter any time the Pump and/or Motor are repaired or replaced. Pump and/or Motor wear usually occurs over a long period and are gradual loses of power and excess heating of Oil. This may go un-noticed until it is severe making the operator think it just started, this can make this type of failure hard to determine. Pre-Mature Pump and/or Motor Failure wear occurs quickly, The problem for these failures must be found and repaired or the failure will be repetitive. The Most common cause of Pre-Mature Failure is Cavitation, Oil Contamination, Oil Aeration and/or Defects in Pump and/or Motor. MACHETE SPECIFIC, When performing the Flow Test on the Machete, The flow going to Motor and either the return from the Motor or the Case drain must be determined. These figures will indicate internal leakage in the Motor.

CAUSE: **Air in Oil?**
SOLUTION: Run the System for a few minutes. Check for Air in the Oil in the Tank. Air entrained Oil will have a foamy appearance. If Air is present, find the Air Leak and correct it. Air Leak can be in the Suction Line and Oil may not leak out because there may only be Oil in that location when the Pump is sucking it in. With the Tractor Engine "Off" you can find a leak by pressurizing the Tank; This will not take but a few pounds of pressure (3 to 5 PSI or Less) look for leakage in the Suction Lines, Because the Oil Pick-Up is lower than the Oil Level this will force Oil out the leak. Leaks in Hoses and at Fittings can draw Air into System as Oil Flows Past. Systems that have had severe or prolonged Air Entry Problems may have Experienced Pump Damage.

CAUSE: **Engine RPM Too Slow?**
SOLUTION: Run Tractor Engine at required Speed to achieve GPM through Pump, See Specification Section in Repair Manual.

CAUSE: **Vent Plug Block or Not Installed?** (Power One Way Cylinders)
SOLUTION: This applies to Cylinders that only Stroke in or Out under pressure, The return Stroke under gravity. Remove Plug, Clean or Replace as needed. If No Vent Plug is there determine if one is needed and install as required. (See Parts / Operators Manual for Vent Plug requirements).

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Cylinder Rod Bent:

CAUSE: **Excessive Load Applied to Cylinder?**
SOLUTION: This is an Operational Problem or Operational Accident. The Mode of failure would be that an excessive load was applied while the Control Valve Spool was in “Hold” and there was no Work Port Relief in circuit (or it was malfunctioning). Corrective action is to counsel the operator to avoid conditions that resulted in bending. repair or replace Cylinder and any other damaged component. A good example would be using Tractor Wheel Power to put pressure against boom and Valve closed so Cylinder can not give (Exceeding Break-A-Way).

CAUSE: **Misalignment of Cylinder Lugs?**
SOLUTION: make sure something has not been bent, Frame, Lugs and etc. Align Cylinder Lugs (may require cutting and Welding) or replace faulty Parts as needed. Mis-Alignment of Lugs place a side load on Rods that can cause them to bend. Usually this alignment is noticeable.

CAUSE: **Work Port Relief Malfunction?**
SOLUTION: Check relief Pressure of Valves that are in the affected circuit. Adjust or replace them as needed to bring them to specification (See Repair Manual). Do not operate with Relief Setting incorrect, this will cause damage. Also check to make sure that Port Relief’s are installed correctly and in the proper places.

CAUSE: **Interference with Another Part of Component?**
SOLUTION: Repair or Replace the damaged cylinder. Slowly actuate the Implement throughout its full range of motion, utilizing all possible Cylinders. Observe for interference with any other Part. Correct cause of interference as needed.

Cylinder Rod Came Out of Cylinder:

CAUSE: **Piston Nut Backed Off of Rod?**
SOLUTION: Replace damaged Parts and Assemble. Make sure Piston Nut is Correct and Properly Torqued. This problem is usually caused by improper assembly (Nut Not Torqued) but can also be caused by a faulty Nut and/or Rod threads, This failure would show Rod Threads that are damaged most likely. Some times Threads will show damage from Piston working on Rod because it has been operated while Nut was loose.

CAUSE: **Wrong Nut On Rod?**
SOLUTION: Replace with correct Piston Nut, Check Piston Nut that it is not too Thin, Wrong Threads or Insufficient Thread engagement on Rod.

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Cylinder Rod Came Out of Cylinder: (Continued)

CAUSE: **Relief Valve Setting Too High?**

SOLUTION: After Replacing the damaged Parts, test the Settings of the Relief Valve, Test this by slowly pressurizing the Cylinder to determine the Relief Pressure, a Pressure Gauge installed inline for testing will show this Relief Pressure. If Pressure exceeds what Relief Should be stop. Repair or replace Relief Valve and retest. IF RELIEF IS TO HIGH DO NOT CONTINUE WITH PRESSURE UNTILL RELIEF IS REPAIRED OR DAMAGE WILL RESULT. Note: Usually Rods that have Nuts pulled off due to Pressure to high will have Threads pulled off of Rod.

Deck Cracks:

CAUSE: **Severe Usage?**

SOLUTION: Prepare and Repair, Weld, Grind Down, Add Scab Plate and Re-Paint Repaired Area.

CAUSE: **Vibration?**

SOLUTION: Locate and correct cause of Vibration problem. Prepare and Repair, Weld, Grind Down, Add Scab Plate and Re-Paint Repair Area.

CAUSE: **Poor or Missing Welds, Missing Bracing?**

SOLUTION: Prepare and Repair, Weld, Grind Down, Add Scab Plate and Re-Paint Repaired Area. As this will usually be found rather quickly from delivery date it should be covered under warranty, always take photos of this before any repairs as they may be requested by factory.

CAUSE: **Inadequate Bracing?**

SOLUTION: This is a difficult subject, It is recommended that you consult with the factory before making modifications of this type, Adding additional pieces may change many components functions, the weight added could affect balance weight ratio and the Hydraulic Functions ability to lift.

Deck Worn on Underside:

CAUSE: **Mowing Over Sand or Other Abrasive Material?** Under side of deck has Sand Blasted appearance. This Sand Blasted appearance will also be visible on Blades and Carrier, most severe on Fan Blades (Up-Lift Blades).

SOLUTION: 1. Run Mower with as low a Tractor RPM as Possible (Decreased PTO Speed) and still get a satisfactory Mowing job done. Use Flat non Up Lift Blades is available. Try to do the mowing at a time when the ground is still damp (earlier in day).
2. Check to make sure mower is operating at correct RPM (540 or 1000 as required by mower components). If a 540 RPM mower was connected to a 1000 RPM Tractor the Blade Tip Speed would be way to high and this would create severe amount of Sand and Dust under deck.

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Deck Worn on Underside: (Continued)

CAUSE: **Deck being Worn and Ripped away by Heavy Debris?**
SOLUTION: Make sure material being cut is not to heavy, large or thick for unit being used, This type wear will be accompanied by dents and large scratches. The best solution for this is to make sure that Unit is suited for job. Make sure job is not over tasking Unit.

CAUSE: **Deck Worn from Continuous Use?**
SOLUTION: The Deck will wear over time, If Deck had severe wear by sand or other debris at one time causing excess (premature) wear, then this will make it wear that much faster and the only solution would be to replace Deck.

Hydraulic System Noise: (Squeal)

CAUSE: **Restrictions in System?** A Squeal may be normal in some Valves when the lowering function is actuated as Oil is going over restrictors.
SOLUTION: Check Hoses and Lines for Kinks / Obstructions. Hoses have an inner lining that can turn loose and block a hose. If Assembly or Repair work has been performed, recheck all connections for correct location. Some may not be visible without some disassembly. Unplanned restrictions cause increased backpressure, loss of usable power and excess heating of Oil. Restrictions can sometimes be found by measuring the temperature of the Oil (or fittings) at various points in circuit as heat will usually be higher at the restriction. The restriction should be located at or upstream of the increased temperature point. Foreign objects that get into the system sometimes cause restrictions, This can happen during servicing, maintenance or repairs. It is not uncommon to find bolts, nuts, plastic plugs, paper or rags stuck into system when it was being repaired or assembled then forgotten about. Restrictions sometimes can be a piece off of a failed component up stream or a Component such as a Hose built wrong

CAUSE: **Relief Valve Malfunction?**
SOLUTION: Perform Flow Pressure Test. If Flow is correct and Pressure is Low, remove Relief Valve and inspect for damaged Seals, Contamination or other abnormalities. Re-Seal, Adjust or replace the Valve as needed. Leakage through the Valve (from Low Pressure setting) or leakage around the Valve from damaged Seals will cause heating of the Oil and Low Power complaints. NOTE: There may be situations when Pump Flow is insufficient to reach Relief Pressure. Therefore it is important to test for proper Flow before condemning the Relief Valve.

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Hydraulic System Noise: (Continued)

CAUSE: **Cavitation?** Cavitation is caused by inadequate amount of fluid reaching the Pump, Cavitation will damage Pump, so do not run with a Cavitation problem any more than necessary to check system. If Suction side is pulling Air in the Oil will usually cause Oil to Foam after running some.

SOLUTION: Cavitation is usually caused by a restriction of some sort in the suction lines, but can also be caused by an un-vented tank which creates a vacuum when the pump has a demand for Oil. Other problems such as plugged Suction Screens or very thick Oil can cause cavitation. The cause must be found and corrected before a new Pump is installed as cavitation will damage a Pump. Repair or Replace components a required.

CAUSE: **Wrong Oil?** (Oil to Thick or Viscous)

SOLUTION: Make sure correct Oil is used, Recommended Hydraulic Oil only should be used. Do not mix grades and types of Oil, if wrong oil has been used it must be completely remove before adding different types Oil. See Specification Chart for recommended Oil type

Hydraulic System Overheating:

Note:

1. Overheating of the Hydraulic System can have many individual causes. Before going too far into trouble shooting an overheating complaint it would be well to understand exactly the difference between HOT and TO HOT.

2. Heat is produced anytime a Hydraulic System is working. Heat is generated when the Oil moves from an area of High Pressure to an area of Low Pressure. These “Pressure drops” occur when work is performed by the System and normally occurs in Pumps, Motors, Hoses and Valves. They are expected and allowed for in the design of the System.

3. Alamo Industrial’s Systems are designed to operate at approximately 100 Degrees F. above ambient temperature (Ambient Temperature measured close to Tank) with the proper Oil Level in tank and System. Small variances can be expected due to normal wear in the System and other environmental conditions. A System is not considered to be overheating unless it significantly exceeds 100 degree F. over ambient temperature. This is not to be measured by touching, use a temperature measuring device to measure temperature to avoid being burnt.

4. When Discussing the Problem with a Customer, it is important to determine the condition under which the Symptoms occur. For example, Ask if the Symptom has existed for the life of the machine, has been gradually getting worse, or if it has occurred suddenly. A sudden occurrence might indicate that foreign material entered the system when work was being performed. Gradual worsening would indicate internal leakage (Wear or Breakage). Symptoms that occur with specific operators would indicate a possible operational problem. Symptoms that have been present for some time could be any of the above problems.

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Hydraulic System Overheating: (Continued)

CAUSE: **Restrictions?** Just as indicated, an unintentional obstruction to normal Oil Flow through the circuit.

SOLUTION: Check for an unwanted increase in pressure, The obstruction would be down stream from the Pressure increase, so you would want to check pressure going back toward pressure inlet. As Oil passes through the obstruction it causes Heat increase, a check of temperatures will generally be near restriction, a heat sensing gun works well for this. Some Examples of Restrictions are:

- Kinked, Mashed or Internally Broken Hoses.
- Obstruction by foreign materials in lines.
- Plugged Filter or Wrong Filters installed
- Open (Stuck) By Pass Valve
- Wrong Size Hoses or fittings installed.
- Repair work done and parts assembled wrong.

The number of possibilities is numerous, Do not forget when checking especially for kinks in hoses it may be required to run the cylinders through their complete range of movement to check them. Know what repair work or modifications were performed.

CAUSE: **Wrong Type Valve being Used For Tractor?** (Tractor Hydraulics Only)

SOLUTION: Determine type of Control Valve for Tractor, Is tractor a Fixed Displacement (Open Center) System or a Load Sense (Closed Center) System. Make Sure the Valve that is installed is the correct one for the Type Tractor Hydraulics be used. If the Wrong System is Used it will cause a Heating problem.

CAUSE: **Spool Valve Stuck In Open or Partially Open Position?**

SOLUTION: Repair or Replace Valve components as needed.

CAUSE: **Relief Valve Set to Low?** (Load Sense / Closed Center Only)

SOLUTION: Relief Valve for Mower Positioning Control Valve must be set higher than Tractor Relief Valve, Otherwise the Oil will bypass continuously and overheat rapidly.

CAUSE: **Leakage?**

SOLUTION: This type Leakage is Internal, an External Leak will not cause Heating unless it causes enough Oil loss to effect the Oils cooling. Another type leakage would be Air entering the system on the suction side, This may not leak externally when system is engaged because it would be a suction. Some internal leakage is always present because of tolerance in the components, Valve, Pump, Motor and other components. But usually this is compensated for in the design of the system and components. Internal leakage will normally increase with wear and age on the system components. Heating from normal internal leakage is usually not severe or noticeable until it reaches advanced stages. It usually occurs gradually and is accompanied by a gradual loss of power. Test System for leakage by running Pressure and flow Test, Rebuild or Replace as required.

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Hydraulic System Overheating: (Continued)

CAUSE: **Excessive Pump or Motor Wear?** These will be accompanied by a Power Loss when Mower Head is Cutting. Rapid Pump and/or Motor wear can be from damage caused by Cavitation (restricted Oil Supply), Contamination, Aeration, or defects in the Pump and Motor. Air Leaks (Air being sucked into system) causes Air Bubbles to be entrained into the Oil. These Air Bubbles will reduce the lubricating ability of the Oil causing adhesive wear to the Pump and Motor and a rapid increase in internal leakage, Air entrained Oil will have a foamy look after the system has run for a while.

SOLUTION: Test System for excessive Pump and Motor Wear or Cavitaion by running Pressure and flow Test, Repair or Replace as required.

CAUSE: **Engine RPM Too High?**

SOLUTION: Run Tractor Engine at required Speed to achieve GPM through Pump, See Specification Section in Repair Manual.

CAUSE: **Malfunctioning Valves?** (Main Relief, Priority Valves and Logic Valves)

SOLUTION: Test the above Valves, they are on the High Pressure Side of the system, these act on a pressure differential and are spring loaded. The Typical failure is a Leaking Seal between the Valve Cartridge and the Valve Block. An improper Low setting of Relief Valve to Low a Pressure can cause rapid Heating as the Oil passes from the High Pressure to the Low-Pressure area. The same is true for the other Spring Type Valves such as the Priority Valve (Governors).

CAUSE: **Operational Problems?** (Cutting Excessively Heavy Material, Traveling to Fast for Conditions, Improper Cutting Height)

SOLUTION: Make sure Cutting Height is not so low Blades are hitting Ground. Make sure that Travel Speed while cutting does not exceed cutting capacity of Model Design. Make sure something too heavy for this model is not being cut. Make Sure the Tractor Engine is running at the correct RPM to run Hydraulics at the correct Speed. All of these can cause Over Heating by forcing the system pressure over relief (causing Relief Valves to Open and heating the Oil as it passes across the Valve). If the system pressure is going over relief too frequently or for too long at a time, The Oil capacity will not be sufficient to maintain the desired operating temperature. Travel Speed is always dependent on the material being cut.

Motor Flange Breaking:

CAUSE: **Insufficient Support on Upper End of Motor?**

SOLUTION: 1. Make sure that the Motor Plate is installed on top of Motor and that it is installed correctly, These Plates must be installed with clearance dimensions and Torque settings, See the Spindle repair instruction in the Operators / Product Service Manual.
2. Some Units built prior to 1996 did not have this Motor Plate on it, There was a kit made to add to these early units. Kit P/N 02970754 can be used to add Motor Plate to Units made prior to 1996.

CAUSE: **Motor to Spindle retaining Bolts not Tight?**

SOLUTION: Check and Tighten Motor to Spindle Mounting Bolts.

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Motor Inoperative: (Won't Run)

CAUSE: **Low Oil Level or No Oil?**
SOLUTION: Check and Correct Oil Level, If oil level was extremely Low or Empty, Pump Damage most likely has occurred, This will also have to be checked. Repair any cause of Oil loss before continuing.

CAUSE: **No Oil Flow to Motor?** Front Pump Inoperative, No Pump Pressure reaching Motor.
SOLUTION: Oil Level is correct but no Oil Flow to Motor. Check Pump connection to Tractor, Shafts, Couplers and Adapters, make sure they are not stripped or broken. Check to make sure Pump is "ON" if equipped with Pump "Shut Off". Check to make sure Motor is "ON" when equipped with "Shut Off". Check for any malfunctions in Drive System and Shut Off Components.

CAUSE: **No Voltage to Solenoid Valve?** (If Equipped)
SOLUTION: Check Fuse (if used), replace if required and try again. With Tractor Ignition Switch "ON", and Mower Switch "ON" Test for voltage at the Solenoid Valve. A quick test is to turn switches on (With Tractor Engine "Off") and see if a small metal object such as a paper clip or washer will stick to the end of the Valve when the mower is turned "ON". If it does not, The Coil is not magnetizing the Valve. Test for Voltage at the Wire using a test Light or Voltmeter. If no Voltage is present, trace the circuit back through the wiring, the Mower Switch, The Fuse and the Tractor Wiring to locate the faulty part. If Current is available to the Solenoid but Solenoid won't turn on motor replace Solenoid.

CAUSE: **Spindle Locked Up?**
SOLUTION: The Spindle can be locked up causing Motor not to Start, This can usually be felt or seen in the System trying to run but having to bypass. Sometimes the Spindle is not seized but only tight, this can prevent motor from starting right away from a dead Stop or slowly start, The tightness is not enough to prevent motor from running once it is started, See the Spindle Section for more information.

Motor Over Heating: (Motor Over Heating is considered when the Operating temperature exceeds 100 degrees F. over ambient Temperature).

CAUSE: **Oil Level Too Low?**
SOLUTION: Make sure it is filled to proper level with recommended Oil. Determine reason for low Oil Level (leaks, etc.) and correct problem, Run Mower and check temperature, it should not exceed 100 degree F. above ambient Temperature.

CAUSE: **Incorrect Oil Used?**
SOLUTION: Use recommended Hydraulic Oil, DO NOT mix Oils that are not compatible, in some cases it may be required to drain and replace all the oil. See Specification Chart for recommended Oil Type. When repairing unit it is recommended that Oil be update to recommended Oil.

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Motor Over Heating: (Continued)

CAUSE: **Air in Oil?**

SOLUTION: Run the System for a few minutes. Check for Air in the Oil in the Tank. Air entrained Oil will have a foamy appearance. If Air is present, find the Air Leak and correct it. Air Leak can be in the Suction Line and Oil may not leak out because there may only be Oil in that location when the Pump is sucking it in. With the Tractor Engine Off you can find a leak by pressurizing the Tank, This will not take but a few pounds of pressure (10 PSI or Less) look for leakage in the Suction Lines, Because the Oil Pick-Up is lower than the Oil Level this will force Oil out the leak. Leaks in Hoses and at Fittings can draw Air into System as Oil Flows Past. Systems that have had severe or prolonged Air Entry Problems may have Experienced Pump Damage.

CAUSE: **Engine RPM Too High?**

SOLUTION: Run Tractor Engine at required Speed to achieve GPM through Pump, See Specification Section in Repair Manual.

CAUSE: **Excessive Ground Speed for Mowing Conditions?** (Operational Problem)

SOLUTION: This will usually also have a Heating Problem if continuing to mow. Observe (or Ask Operator) mowing conditions, Material being Cut etc. Correct Ground Speed is always relative to Material and conditions of mowing. One indication of Excessive Ground Speed is considerable wear on tips of blades but this is not exclusive of Excessive Ground Speed as the Wear can be caused by other factors. So Blade Wear alone is not definite Travel Speed problem. The Cut is Choppy and uneven, the material is coming from under deck in Lumps instead of being distributed across width of Deck. These conditions can force the Oil to go over relief because of excessive Load on Motor. A Change of Ground Speed and/or material being cut by unit will cure this problem.

CAUSE: **Excessive Ground Contact with Blades?** (Operational Problem)

SOLUTION: Inspect Blades, Blade Carrier and Blade Bolts for wear, Excessive wear could indicate frequent contact with the ground, Check cutting Height of Blades above Skid Shoes, Check for proper Blades and Skid Shoe condition, Repair or Replace as required.

CAUSE: **Incorrect Oil Installed?**

SOLUTION: Incorrect Oil installed may produce internal wear, which will overheat the motor. Use only the recommended Oil for the model being used. See Specification Chart for correct Oil type. Do not mix Oil Types as the may not be compatible, if types of Oil are being changed over, completely change the Oil, Drain and flush the system before installing the new Oil.

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Motor Over Heating: (Continued)

CAUSE: **Excessive Internal Leakage in Pump / Motor?**

SOLUTION: Perform Flow and Pressure Test. If results are not within Specifications, determine the cause of the internal leakage, correct the cause. Replace worn or damaged parts. It is good to replace the Filter any time the Pump and/or Motor are repaired or replaced. Pump and/or Motor wear usually occurs over a long period and are gradual loss of power and excess heating of Oil. This may go un-noticed until it is severe, making the operator think it just started, this can make this type of failure hard to determine. Pre-Mature Pump and/or Motor Failure wear occurs quickly, The problem for these failures must be found and repaired or the failure will be repetitive. The Most common cause of Pre-Mature Failure is Cavitation, Oil Contamination, Oil Aeration and/or Defects in Pump and/or Motor. MACHETE SPECIFIC, When performing the Flow Test on the Machete, The flow going to the Motor and either the return from the Motor or the Case drain must be determined. These figures will indicate internal leakage in the Motor.

CAUSE: **Relief Valve Malfunction?**

SOLUTION: Perform Flow Pressure Test. If Flow is correct and Pressure is Low, remove Relief Valve and inspect for damaged Seals, Contamination or other abnormalities. Re-Seal, Adjust or replace the Valve as needed. Leakage through the Valve (from Low Pressure setting) or leakage around the Valve from damaged Seals will cause heating of the Oil and Low Power complaints.
NOTE: There may be situations when Pump Flow is insufficient to reach Relief Pressure. Therefore it is important the proper Flow be present before condemning the Relief Valve.

CAUSE: **Restrictions in System?**

SOLUTION: Check Hoses / Lines for Kinks/Obstructions. Hoses have inner linings that can turn loose to block it. If assembly or Repair work has been performed, recheck all connections for correct location. Some may not be visible without some disassembly. Unplanned restrictions cause increased backpressure, loss of usable power and excess Heating of Oil. Restrictions can sometimes be found by measuring the temp of the Oil (or fittings) at various points in circuit for higher heat. The restriction should be located at or upstream of the increased temp. point. Foreign objects sometimes cause restrictions in the system,
This can happen during servicing, maintenance or repairs. It is not uncommon to find bolts, nuts, plastic plugs, paper or rags stuck into system when it was used as being repaired or assembled then forgotten about. Restrictions sometimes can be a piece off of a failed component up stream, a Component such as a Hose built wrong.

CAUSE: **Insufficient Flow From Charge Pump?** (MACHETE SPECIFIC)

SOLUTION: Measure Flow from charge Pump (Install Flowmeter in series upstream of Charge Filter). If Flow is significantly less than 6 GPM at rated RPM. Replace the Pump Assembly and retest for proper Flow.

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Motor Shaft Seal Leaking:

CAUSE: **Excessive Back Pressure on return side of Motor?** (Constant or Intermittent)
SOLUTION: Check for restrictions on the return side of Motor (See Overheating in General). Check all return Plumbing for kinked hoses or hoses that can Kink in various positions of the Cutting Head or Boom. Look for plugged Lines or a Plugged Filter. Check also for other Valves or add-on components downstream of the motor that can stop or restrict the Flow of Oil. Do not just replace the Seal without curing the problem, if you do it will likely happen again.

CAUSE: **Incorrect Oil Used?**
SOLUTION: Use recommended Hydraulic Oil, DO NOT mix Oils that are not compatible, in some cases it may be required to drain and replace all the oil. See Specification Chart for recommended Oil Type. When repairing unit it is recommended that Oil is updated to recommended Oil.

CAUSE: **Shaft Seal Worn?**
SOLUTION: This is usually visible damage. Replace Seal if Shaft is NOT also worn, If Shaft is worn (Groove or scratches in Shaft) it is advisable to replace the Motor. Seal and Shaft wear are normally caused by abrasive material (dirt) getting around the Seal, Damage can also occur from damaged Spindle Assembly. What ever the cause it must be corrected before new Motor is installed.

CAUSE: **Shaft Seal Coming Out of Bore?**
SOLUTION: Check Seal retainer if equipped to make sure that retainer is of proper size and installed properly. Install New Seal and proper retainer, But always try to find the cause of Seal blowing out to correct the problem.

CAUSE: **Faulty Motor?**
SOLUTION: Motors can leak at the Shaft Seal due to internal wear, Damaged Internal Seals or Improper Assembly. Repair or Replace as required.

Motor Runs Too Slow: (Or Slows Down under Load)

Note: The Motor on the Cutting Head running too slow can be a result of many causes and not all caused by the Motor itself. It needs to be determined whether the Symptom occurs by itself or if it is accompanied by other symptoms such as overheating, unusual noise, etc. The question should be asked whether the symptom occurs when the mower is freewheeling or only when the Mower is cutting under a load (light or heavy grass). If the Motor only slows when under a load see Motor Stop Section. If Mower Loads and not under a Load see the following Section Motor runs to Slow.

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Motor Runs Too Slow: (Continued)

CAUSE: **Engine RPM Too Slow?**
SOLUTION: Run Tractor Engine at required Speed to achieve GPM through Pump, See Specification Section in Repair Manual.

CAUSE: **Pump Drive Damaged?**
SOLUTION: Inspect Pump Drive components for wear or damage, If Pump is not being driven properly, repair or replaced parts as required.

CAUSE: **Faulty Logic Valve in Motor Control Circuit?** (If Equipped)
SOLUTION: Remove and inspect Logic Cartridge for damaged seals or contamination, Repair, Reseal or Replace as needed. If the Seals on the Logic Valve repeatedly fail, it will likely be required to replace the Valve Block due to damage or erosion in the Valve Bore.

CAUSE: **Air in Oil?**
SOLUTION: Run the System for a few minutes. Check for Air in the Oil in the Tank. Air entrained Oil will have a foamy appearance. If Air is present, find the Air Leak and correct it. Air Leak can be in the Suction Line and Oil may not leak out because there may only be Oil in that location when the Pump is sucking it in. With the Tractor Engine Off you can find a leak by pressurizing the Tank, This will not take but a few pounds of pressure (10 PSI or less) look for leakage in the Suction Lines, Because the Oil Pick-Up is lower than the Oil Level this will force Oil out the leak. Leaks in Hoses and at Fittings can draw Air into System as Oil Flows Past. Systems that have had severe or prolonged Air Entry Problems may have Experienced Pump Damage.

CAUSE: **Restrictions in System?**
SOLUTION: Check Hoses / Lines for Kinks/Obstructions. Hoses have inner linings that can turn loose to block it. If Assembly or Repair work has been performed, recheck all connections for correct location. Some may not be visible without some dis-assembly. Unplanned restrictions cause increased backpressure, loss of usable power and excess Heating of Oil. Restrictions can sometimes be found by measuring the temperature of the Oil (or fittings) at various points in circuit for higher heat. The restriction should be located at or upstream of the increased temperature point. Foreign objects sometimes cause restrictions in the system, This can happen during servicing, maintenance or repairs. It is not uncommon to find bolts, nuts, plastic plugs, paper or rags stuck into system when it was used as being repaired or assembled then forgotten about. Restrictions sometimes can be a piece off of a failed component up stream, Component such as a Hose built wrong.

CAUSE: **Damaged O-Ring on Solenoid Valve?** (If Equipped)
SOLUTION: Remove Valve and inspect Seals, replace if damaged.

CAUSE: **Insufficient Flow From Charge Pump?** (MACHETE SPECIFIC)
SOLUTION: Measure Flow from charge Pump (Install Flowmeter in series upstream of Charge Filter). If Flow is significantly less than 6 GPM at rated RPM. Replace the Pump Assembly and retest for proper Flow.

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Motor Runs Too Slow: Continued

CAUSE: **Excessive Internal Leakage in Pump / Motor?**

SOLUTION: Perform Flow and Pressure Test. If results are not within Specifications, determine the cause of the internal leakage, correct the cause. Replace worn or damaged parts. It is good to replace the Filter any time the Pump and/or Motor are repaired or replaced. Pump and/or Motor wear usually occurs over a long period and are gradual loss of power and excess heating of Oil. This may go unnoticed till it is severe making the operator think it just started, this can make this type of failure hard to determine. Pre-Mature Pump and/or Motor Failure wear occurs quickly, The problem for these failures must be found and repair or the failure will be repetitive. The Most common cause of Pre-Mature Failure is Cavitation, Oil Contamination, Oil Aeration and/or Defects in Pump and/or Motor.

NOTES:

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Motor Stops: (Mower Quits Under Load)

CAUSE: **Incorrect Oil Used?**
SOLUTION: Use recommended Hydraulic Oil, DO NOT mix Oils that are not compatible, in some cases it may be required to drain and replace all the oil. See Specification Chart for recommended Oil Type. When repairing unit it is recommended that Oil is updated to recommended Oil.

CAUSE: **Air In Oil?**
SOLUTION: Run the System for a few minutes. Check for Air in the Oil in the Tank. Air entrained Oil will have a foamy appearance. If Air is present, find the Air Leak and correct it. Air Leak can be in the Suction Line and Oil may not leak out because there may only be Oil in that location when the Pump is sucking it in. With the Tractor Engine Off you can find a leak by pressurizing the Tank, This will not take but a few pounds of pressure (10 PSI or Less) look for leakage in the Suction Lines, Because the Oil Pick-Up is lower than the Oil Level this will force Oil out the leak. Leaks in Hoses and at Fittings can draw Air into System as Oil Flows Past. Systems that have had severe or prolonged Air Entry Problems may have Experienced Pump Damage.

CAUSE: **Engine RPM Too Slow?**
SOLUTION: Run Tractor Engine at required Speed to achieve GPM through Pump, See Specification Section in Repair Manual.

CAUSE: **Excessive Ground Speed For Mowing Conditions?** (Operational Problem)
SOLUTION: This will usually also have a Heating Problem if continuing to mow. Observe (or Ask Operator) mowing conditions, Material being Cut etc. Correct Ground Speed is always relative to Material and conditions of mowing. One indication of Excessive Ground Speed is considerable wear on tips of blades but this is not exclusive of Excessive Ground Speed as the Wear can be caused by other factors. So Blade Wear alone is not definite Travel Speed problem. The Cut is Choppy and uneven, the material is coming from under deck in Lumps instead of distributed across width of Deck. These conditions can force the Oil to go over relief because of excessive Load on Motor. A Change of Ground Speed and/or application will cure this problem.

CAUSE: **Excessive Internal Leakage in Pump / Motor?**
SOLUTION: Perform Flow / Pressure Test. If results are not within Specifications, determine cause of the internal leakage, correct the cause. Replace worn / damaged parts. It is good to replace the Filter anytime the Pump and/or Motor are repaired or replaced. Pump and/or Motor wear usually occurs over a long period and are gradual loss of power and excess heating of Oil. This may go unnoticed till it is severe making the operator think it just started, this can make this type of failure hard to determine. Pre-Mature Pump and/or Motor Failure wear occurs quickly, The problem for these failures must be found and repaired or the failure will be repetitive. The Most common cause of Pre-Mature Failure is Cavitation, Oil Contamination, Oil Aeration and/or Defects in Pump and/or Motor.

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Motor Stops: (Mower Quits) Continued

CAUSE: **Low Relief Valve Setting?**
SOLUTION: Best Tested with Pressure / Flowmeter, Some Relief Valve can be Repaired, Some Only Replaced, See Assembly set up instruction on Relief Valves, See Specification Section on Relief valve Settings. DON'T exceed recommended Relief Settings. Before condemning Relief Valve do a Flow and Pressure Test, The Pump under some conditions can't build enough pressure to make the relief open and this would appear Relief Valve is stuck, A Flowmeter will show when Pressure Relief opens.

CAUSE: **Restrictions in System?**
SOLUTION: Check Hoses / lines for Kinks / Obstructions. May not be visible without disassembly. Unplanned restrictions cause increased back pressure, loss of usable power and excessive heating of Oil (Usually at the restriction). Restrictions can sometimes be found by checking different locations for the temperature, The restriction will generally be upstream of heated spot. There are a number of things that can cause this heating problem, Most common Problem, Contamination, Kinked or Damaged Hose,

Pump Seizure: (Pump Locking Up)

CAUSE: **Lack of Oil?** (Lubrication)
SOLUTION: This is normally caused by failure to Pre-Lube the Pump before starting or cavitation (Air or Lack of Oil) during operation. A Lack of Pre-Lube failure will occur soon after start up if Pre-Lube is not done when unit is assembled. Obstruction or damage to Intake (Suction) Side of Pump or Lines can cause this problem. The solution would be to determine what is damaged and why was Oil Low, Repair or Replace as required

CAUSE: **Improper Assembly?**
SOLUTION: Damage can be caused by over torquing the Pump components, incorrect alignment or location of components. Improper Torquing or Assembly will normally show up very soon after start up. The solution would be to determine what is damaged and why, Repair or Replace as required

CAUSE: **Faulty - Defective Pump?**
SOLUTION: Sometimes Oil passages are not open inside the Pump during Manufacturing. These problems will show up as early Bearing failures or Pump not working when installed and very seldom occur after being run for awhile unless there is debris or other contamination blocking something. The solution would be to determine damage, why, and Repair or Replace as required

CAUSE: **Foreign Material?** (Contamination)
SOLUTION: Objects left in Tank or fall in during service. This can include, Dirt, Pieces of Hose, Plugs, Rags or any other object can be left or get into system. Keep everything clean and account for every thing used when serviced. The solution is to determine what is damaged and why, Repair/ Replace as required.

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Pump Wear: (Rapid Excessive Wear)

CAUSE: **Contamination In System?**

SOLUTION: Locate and correct source of contaminants, This could include the complete system, Pump, Motor, Valves, Hoses, Tank, Oil, Filter System or any other component including your source of replacement Oil Supply. The Contaminants must be found and completly removed and stopped. The Solution is to repair or replace worn parts, Completly Flush and Clean all Hydraulic Components, Install New Clean Recommended Oil.

CAUSE: **Cavitation?**

SOLUTION: Cavitation is caused by inadequate amount of Fluid (Hydraulic Oil) reaching Pump, Usually a restriction of some sort in the suction lines but can also be caused by an unvented Tank. This will cause a vacuum when the Pump starts demanding Oil, The Pump cannot pull Oil out of this vacuum. Other Problems such as plugged Suction Screens or very Thick Oil can cuase cavitation. This must be found and corrected before repairing old Pump ot installing new one.

CAUSE: **Air In The Oil?**

SOLUTION: Run System for a few minutes. Check for Air in the Oil in the Tank. Air entrained Oil has a foamy appearance. If Air is present, find the Air Leak and correct it. Air Leak can be in the Suction Line and Oil may not leak out because there may only be Oil in that location when the Pump is sucking it in. With the Tractor Engine Off you can find a leak by pressurizing the Tank, This will not take but a few pounds of pressure (10 PSI or Less) look for leakage in the Suction Lines, Because the Oil Pick-Up is lower than the Oil Level this will force Oil out the leak. Leaks in Hoses and at Fittings can draw Air into System as Oil Flows Past. Systems that have severe or prolonged Air Entry Problems may have Experienced Pump Damage.

CAUSE: **Pump Not Pre-Lubed before Starting?**

SOLUTION: Repair or Replace Pump, Fill Pump with Oil during Assembly and or before Starting, This can be done by pouring Oil into the Suction Hose and letting it run into Pump as you are connecting Suction Hose, The Pump should have been Assembled using lubricant as it was assembled. The Machete and Brahma this is not required as the Pump is lower than the tank. This will make the suction line full of Oil to Pump

CAUSE: **Incorrect Oil Used?**

SOLUTION: Use recommended Hydraulic Oil, DO NOT mix Oils that are not compatible, in some cases it may be required to drain and replace all the oil. See Specification Chart for recommended Oil Type. When repairing unit it is recommended that Oil is updated to recommended Oil.

CAUSE: **Water In Oil?**

SOLUTION: Moisture in Oil adversely affects the lubricating ability of the Oil. The Source of the Moisture entry must be found and corrected, The System cleaned and flushed, All damaged components replaced. DO NOT operate system with moisture in it because the moisture will turn to Steam when heated, Steam will pit and damage components of Pump, Valves and Motors. As well as the Lubricating ability of the Oil will be diminished.

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Spindle Leaking at Motor:

CAUSE: **Filling Spindle with Hydraulic Oil?** Motor Seal Leaks.
SOLUTION: Determine and correct cause of Motor Shaft Seal Leaking, Re-Seal Motor, Clean Repack or rebuild Spindle as required. Note: Be sure to determine what caused Seal to Blow out and repair that problem before considering the repair to be done. If you just put in New Motor Seal you have not cured the cause of the Problem. See Motor Seal Leaking for possible cause of Seal problems.

CAUSE: **Motor Loose or Bolts Missing?**
SOLUTION: Tighten Motor to Spindle retaining bolts, If they will not tighten? check and repair threads. Notice this problem will let Spindle Oil Leak but will not let Hydraulic Oil from Motor Leak.

CAUSE: **Gasket Torn or Damaged?**
SOLUTION: Remove Motor, Check surface of Spindle Housing and surface of Motor, Clean Surfaces of both, Check for Burrs or deep Scratches. Burrs can be removed by carefully filing surface, If you file surface caution must be taken to keep filings out of Spindle. If Scratches they can be filled with a sealer. Make Sure Sealer is Oil compatible?

CAUSE: **Pressure in Spindle Housing? Excess Backpressure.**
SOLUTION: Make sure Relief Plug installed or Relief Plug is not clogged, Check Spindle Oil level so it is not overfull, Notice this will be Spindle Oil leaking out not Hydraulic Oil.

Spindle Leaking around Bottom Seal:

CAUSE: **Seal Damaged?** Could be damaged by foreign material.
SOLUTION: It will be required to replace Seal and refill Spindle with Lubricant. Before replacing Seal always check to make sure Shaft Bearings have not lost Pre-load (Shaft will be loose in Housing) as this will make Seal Leak and will damage Seal. If Shaft is Loose see next cause / Solution. Always Check condition of Shaft surface at Seal Area that it is not damaged, Always coat ID of Seal with light coat of grease before installing.

CAUSE: **Bearings Loose?**
SOLUTION: If Bearings are Loose the Bearing Pre-Load is lost and Bearings are most likely damaged, Remove Motor, Dis-assemble Spindle, clean and Inspect, Rebuild and Fill with Lubricant. (See Spindle Repair / Product Service manual).

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Spindle Leaking at Relief Plug:

CAUSE: **Relief Fitting Installed in Wrong Hole?**

SOLUTION: 1. First Determine what is leaking, Spindle Oil or Hydraulic Oil, If it is Spindle Oil continue, If it is Hydraulic Oil See Motor Seal Leaking.
2. Sometimes the Fill Plug (Grease Fitting on Spindles that are filled with Grease) and the Relief Fitting are installed in the wrong Holes. The relief Fitting should be in the Upper Hole (Hole closest to the Motor) if there are 2 holes. Note: There were changes made to Spindle in 1996 to add another Hole near the top of the Housing (above Oil Level) for the Relief Fitting to be installed, a Plug was installed into the lower hole where the relief/fill plug was installed as the early spindle only had the one hole. Spindle should always be installed with Pressure and Fill Plugs pointing away from Tractor.

CAUSE: **Spindle Overfilled?**

SOLUTION: Continue running (Only continue to Run if sure Leak is because Spindle is Over Filled) and clean up the mess until the leakage stops or remove some of the lubricant with possibly a suction gun,

Spindle Over Heating:

Spindle will operate up to 200 F. which is considered within tolerance range and is not considered over heating, DON'T Check for over heating with the touch of your Hand, The Temperature is to high and will burn you.

CAUSE: **Low Oil Level in Spindle?**

SOLUTION: Find causes of Low Oil Level and correct it. If Spindle was run Low Lubricant it is likely to be Bearing Damage from lack of Lubricant. The Spindle should be dis-assembled, Inspected and reassembled replacing any damaged parts. Always use New Seals.

CAUSE: **Excessive Bearing Pre-load?** (Bearings to Tight)

SOLUTION: Bearing need to be removed and inspected for damage from running too tight. Rebuild Spindle replacing Parts as required, Always replace with new Seal. Set Bearing Pre-Load and Lock Adjusting and Locking Nut down as instructed in Spindle repair section to correct Specifications, always double check to make sure Nuts are Locked in place.

CAUSE: **Bolts Holding Blade Bar to Spindle replaced and New Bolts to Long?**

SOLUTION: Check that Blade Bar Retaining Bolts are not to Long to cause them to bottom out and jam through Spindle damaging Shaft. Always make sure same Length Bolts are installed that came Out. If to long of Bolts have been installed in Spindle, it will have to be rebuilt.

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Spindle Shaft Loose or Falls Out:

Note: When Spindles are properly assembled and lubricated, The Shaft should not loosen up in service. Shaft loosening up is an indication of a serious internal problem. Merely tightening up the adjusting Nut will not correct the cause of the problem.

CAUSE: **Bearing Adjusting Nut Backed Off?** (Not Properly Locked)
SOLUTION: Dis-Assemble Spindle and inspect Parts for damage, All components have a possibility of being damaged if ran with Bearings Loose. Install required replacement parts and re-assemble. See Spindle repair section for assembly and settings.

CAUSE: **Bearing Cups or Bearing Cones Not Seated Properly?**
SOLUTION: 1. IF MOWER HAS NOT BEEN RUN since Spindle was assembled, Find out why Bearings are not seated and correct problem, readjust Bearing Pre-load and make sure Bearings are seated properly, Fill with Lubricant and Test.
2. IF MOWER HAS BEEN RUN since Spindle was assembled. Dis-Assemble Spindle and inspect Parts for damage, All components have a possibility of being damaged if ran with Bearings Loose. Install required replacement parts and re-assemble. See Spindle repair section for assembly instructions and settings.

CAUSE: **Shaft Falls Out of Spindle Housing?** (Lost Bearing Pre-Load))
SOLUTION: Remove Motor from Spindle Housing and Remove Spindle from Deck. Clean and inspect all Parts, try to determine what part failed and why. Replace Parts as required and re-assemble spindle assembly. Note: Pay close attention to the threads on top of the Shaft where Bearing Adjusting Nuts screw on if using old shaft, make sure that Shaft and Nut Threads are in good shape and compatible. DO NOT use old parts if the fit of them is not correct.

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Spindle Locks Up: (Seizes and will not turn)

CAUSE: **Low Oil Level in Spindle?** (Causing it to Over Heat)
SOLUTION: This will damage almost all parts in Spindle Assembly, the only way to find out is to completely dis-assemble the spindle. Repair and / or Replace as required.

CAUSE: **Excessive Bearing Pre-load?** (Bearings to Tight)
SOLUTION: Bearing needs to be removed and inspected for damage from running too tight. Rebuild Spindle replacing Parts as required, Always replace with new Seal. Set Bearing Pre-Load and Lock Adjusting and Locking Nut down as instructed in Spindle repair section to correct Specifications, always double check to make sure Nuts are locked in place.

CAUSE: **Bolts Holding Blade Bar to Spindle replaced and New Bolts to Long?**
SOLUTION: Check that Blade Bar Retaining Bolts are not too long to cause them to bottom out and jam through Spindle damaging Shaft. Always make sure same Length Bolts are installed that came out. If to long of Bolts have been installed in Spindle, it will have to be rebuilt.

CAUSE: **Seal Protector Damaged?** (Component Bent), The Seal Protector, there has been two types, Old Type was a Cup type that slid up on to bottom of Shaft. This type usually would not stop the Spindle from spinning while running if it got bent, but it could prevent the spindle from starting. The New Type is a Steel Wing that is welded to Blade Bar, it is thicker than old type but it can get bent.
SOLUTION: Check Seal protector type and if damaged repair or replace as required Seal protector can be straighten if damage will allow, as long as it does not hit Housing and protect Seal it will be OK.

Starter on Tractor Will Not Crank:

Note: Most of the problems that will cause the Tractor not to fail to crank will be found in the Tractor, However there are some causes that involve the Mower. Only those problems that are caused by the Mower are covered here, and only mower models that have electrical systems that are tied in with Tractor Electrical system could affect Tractor Starting Circuit.

CAUSE: **Mower "ON" / "OFF" Switch Engaged?**
SOLUTION: Move Mower Switch to the "Off" Position and retry Tractor Starter System. Tractor is not supposed to start when Mower Switch is on, This is a safety feature and is not to be bypassed. When Mower Switch is "Off" the System is internally bypassed to allow the Tractor to Start. Therefore if Switch is "Off" and Starter circuit is not complete through switch, Check Wiring and Switch. Repair or Replace as needed.

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Starter on Tractor Will Not Crank: (Continued)

CAUSE: **Mower "ON" / "OFF" Switch or Wiring Malfunction?**

SOLUTION: CAUTION, MAKE SURE TRACTOR IS IN NUETRAL WITH PARKING BRAKE SET! MAKE SURE ENGINE IS DISABLED TO SO THAT IT WILL NOT SUDDENLY START SHOULD IT START CRANKING, ALSO MAKE SURE EVERYONE AROUND YOU KNOWS THAT THE TRACTOR ENGINE MAY SUDDENLY START CRANKING! THIS BECAUSE WHEN DEALING WITH A SHORT OR LOOSE CONNECTION YOU MAY MOVE IT AND MAKE IT START TO OPERATE!

Check for Voltage at Starter Solenoid when Starter Switch is engaged. If Voltage is not present make Sure Mower Switch is "Off" and recheck for Voltage at Starter Solenoid. If still no Voltage check through circuit till voltage is found (checking must be done with Starter Switch engaged). The faulty component is most likely immediately down stream of the point of voltage. Repair or Replace as needed and retest system. DO NOT BYPASS MOWER SWITCH SAFETY FEATURE!

Tractor Battery Dead or Low:

Note: Most of the problems that will cause the Tractor Battery to fail drain power will be found in the Tractor, However there is a cause that involves the Mower. Only the problem that could be caused by the Mower is covered here, and only mower models that have electrical systems that are tied in with Tractor Electrical system could affect Tractor Battery Circuit.

CAUSE: **"ON" / "OFF" Switch or Joystick Wired Incorrectly?**

SOLUTION: Power Wire from Tractor to Mower control system must be wired through the Tractor Ignition (Key) Switch to where it only has current when Tractor (Key) Ignition Switch is "ON". If the Mower Power Source is connected where it has Power (Constant Power) when Tractor Ignition (Key) Switch is "OFF" it will put a constant Drain on Battery. This is the only one problem that should be able to affect Tractor Battery from Mower Electrical System. Check where Wiring is connected, Correct as required, See Operators, Parts or Repair Manuals for Wiring Schematics.

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